Programmes After Market Services
NPB-1NB Series Transceivers

Troubleshooting

Issue 1 Feb 2001
©Nokia Mobile Phones Ltd.

Table of Contents

Page No

Baseband Troubleshooting 5
Baseband Testpoints 5
Power Schematic - Plots 8
CPU Schematic - Plots 9
Fault Finding Charts 10
1. Phone is Dead 10
2. Flash Programming Does Not Work 10
3. Phone Stays On or is Jammed 13
4. Display Information : “Contact Service” 14
5. No Network Found, No Call Established 16
6. Phone Not Registering to a Network 17
7. Sim Related Errors 18
8. Audio Faults 20
9. Charging Error 22
Baseband Plots 23
Plot1: RFC in Normal Operation 23
Plot 2: Power Up with ACP-7U 24
Plot 3: Power up with ACP-8U 25
Plot 5: Power up with a power variable power supply 27
Plot 6: Power up with Power switch (PWRONx) 28
Plots 7,8,9,10: PCM Clock Tests 29

RF Troubleshooting 32
Introduction 32
Basic Controls with Wintesla 32
Selecting the Phone and the Operating Band 32
RF Controls 33
Tuning the Phone 34
RX Tuning 34
TX Tuning 40
Receiver Fault Finding 44
General 44
Hagar 44
LNA 44
RX-filters 44
Antenna Switch 45
Transmitter Fault Finding 45
General 45
Antenna Switch 45
PA-Module, Directional Coupler and Power Detector 45
HAGAR 46
Synthesizer Fault Finding 46
General 46
VCTCXO 46
VCO 46
RF Testpoints 47

©Nokia Mobile Phones Ltd.

Measuring Points 48
RX 48
TX 49
VCO 50
VCTCXO 51
Other checking points 51
Measurement Points -Waveforms 52

©Nokia Mobile Phones Ltd

This Page Intentionally Blank

©Nokia Mobile Phones Ltd.

Baseband Troubleshooting

Baseband Testpoints

Testpoint	*Net*	*Name*	*Condition*	*DC-level*	*AC-level*
General					
R350	VPP		Flash or emulated EEPROM write	Nominal 2.8 V Min 1.7V, max 2.85 V	
J200	CCONTCSX		Active State	Pulsed active 0V Normal state 2.8 V	
J212	PURX		Power up/down	Reset state 0V Normal state 2.8 V	
R224	PWRON	PWRONX / WDDISX	Power on	Reset state 0V Normal state 2.8 V	
R217	FBUS_TX	FBUS(1)	Power on	Pulsed DC (0V to 2.8V)	
R217	FBUS_RX	FBUS(0)	Power on	Pulsed DC (0V to 2.8V)	
V204	MBUS		Power on	Pulsed DC (0V to 2.8V)	

©Nokia Mobile Phones Ltd

Testpoint	*Net*	*Name*	*Condition*	*DC-level*	*AC-level*
Power supplies					
C201	VB (baseband)		Active state	Nominal 3.6V Min 3.0V, max 4.2V	
C241	VRX		Active state	2.8V Min 2.7V, max 2.85V	
C243	VXO		Active state	2.8V Min 2.7V, max 2.85V	

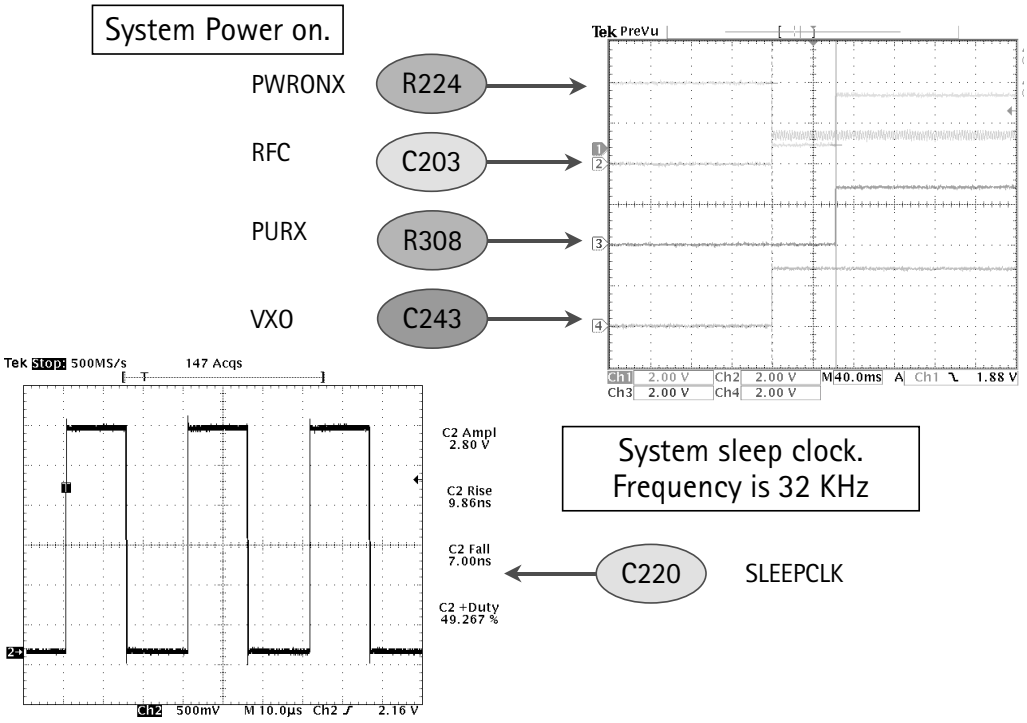
Testpoint	*Net*	*Name*	*Condition*	*DC-level*	*AC-level*
C239	VSYN_1	VCOS (RF)	Active state	2.8V Min 2.7V, max 2.85V	
C240	VSYN_2	Vsynte (RF)	Active state	2.8V Min 2.7V, max 2.85V	
C242	VTX	Vmod (RF)	Active state	2.8V Min 2.7V, max 2.85V	
C209	VBB		Power on	2.8V Min 2.7V, max 2.85V	
C207	VCOBBA		Active state	2.8V Min 2.7V, max 2.85V	
C234	VCP	V5V	Active state	Nominal 5.0V Min 4.8V, max 5.0V	
C225	VSIM		Active state	Nominal 2.8V (3V SIMcard) or 5.0V (5V SIM card)	
C210	VREF_2	VREF	Power on	1.5 V ± 1.5 %	

©Nokia Mobile Phones Ltd.

Testpoint	*Net*	*Name*	*Condition*	*DC-level*	*AC-level*
Clock					
C220	SLEEPCLK	SLCLK	Power on	Pulsed DC (0V to 2.8V)	
C303	RFC	RFCLK	Active state		Typ. 0.8 Vpp (Min 0.5Vpp, Max 2.0Vpp)
J317	COBBACLK	COBBAIF(2)	Active state	Pulsed DC (0V to 2.8V)	
MCU					
J323	MEMC(7)	RAMSelX	Active state	Pulsed, active 0V Non-active 2.8V	
J324	MEMC(0)	ROM1SelX	Active state	Pulsed, active 0V Non-active 2.8V	
J318	MEMC(4)	EsysResetX	Power on	Reset state 0V, normal state 2.8V	

©Nokia Mobile Phones Ltd

Power Schematic - Plots

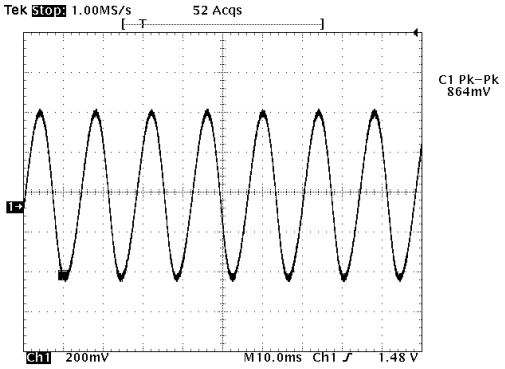


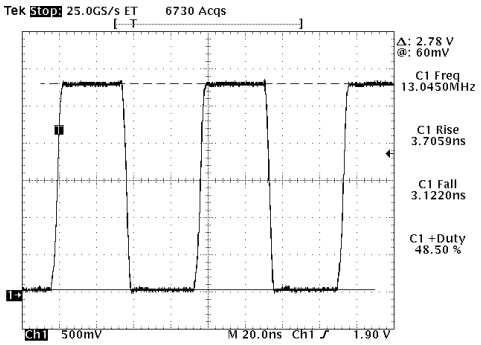
©Nokia Mobile Phones Ltd.

CPU Schematic - Plots

System clock.
Frequency is 13 MHz

RFC C303





Cobba clock.
Frequency is 13 MHz

J317 COBBACLK

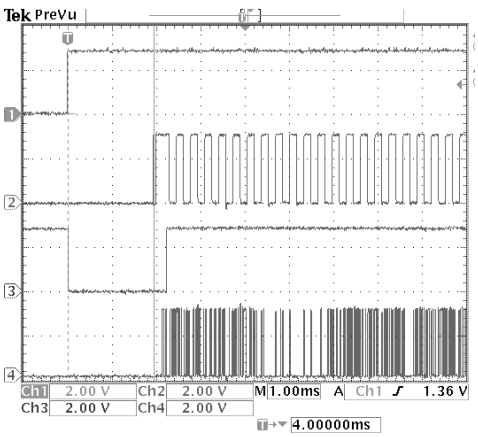
Programming flash

PURX R308

MBUS R307

FBUS[1] - Tx R304

FBUS[0] - Rx R302

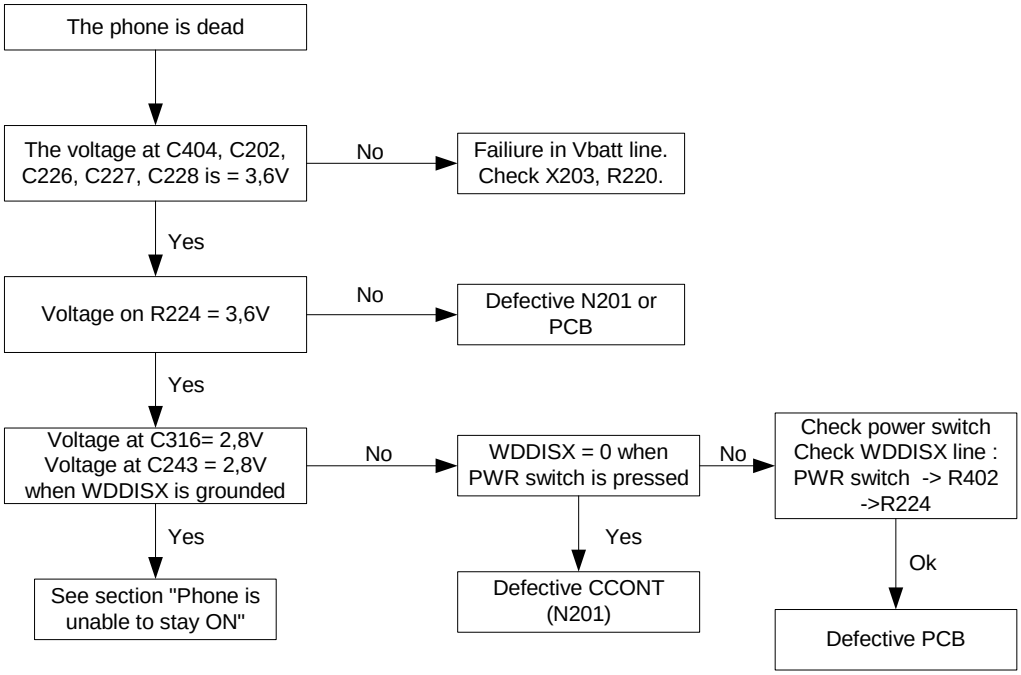


Fault Finding Charts

1. Phone is Dead

"Phone is dead" means that the phone does not take current when the power switch is pressed or when the watchdog disable pin WDDISX is grounded. Nominal supply voltage to the phone is 3,6 V (Vbat voltage). If the battery voltage is below 3,1 V the CCONT prevents the phone from powering up

.


The phone is dead
The voltage at C404, C202, C226, C227, C228 is = 3,6V
No
Failiure in Vbatt line. Check X203, R220.
Yes
Voltage on R224 = 3,6V
No
Defective N201 or PCB
Yes
Voltage at C316= 2,8V Voltage at C243 = 2,8V when WDDISX is grounded
No
WDDISX = 0 when PWR switch is pressed
No
Check power switch Check WDDISX line : PWR switch -> R402 ->R224
Yes
See section "Phone is unable to stay ON"
Yes
Defective CCONT (N201)
Ok
Defective PCB

2. Flash Programming Does Not Work

The flash programming is done in two steps and via two different connectors. FLALI (Flash align - **Production only !!!**) is the first programming step and it is done via the X202 connector. This connector, however is hidden when the PCB is placed in the D-cover and therefore the last programming step must be done via the FINUI (Final UI) connector X201. The two main differences between these two connectors are :

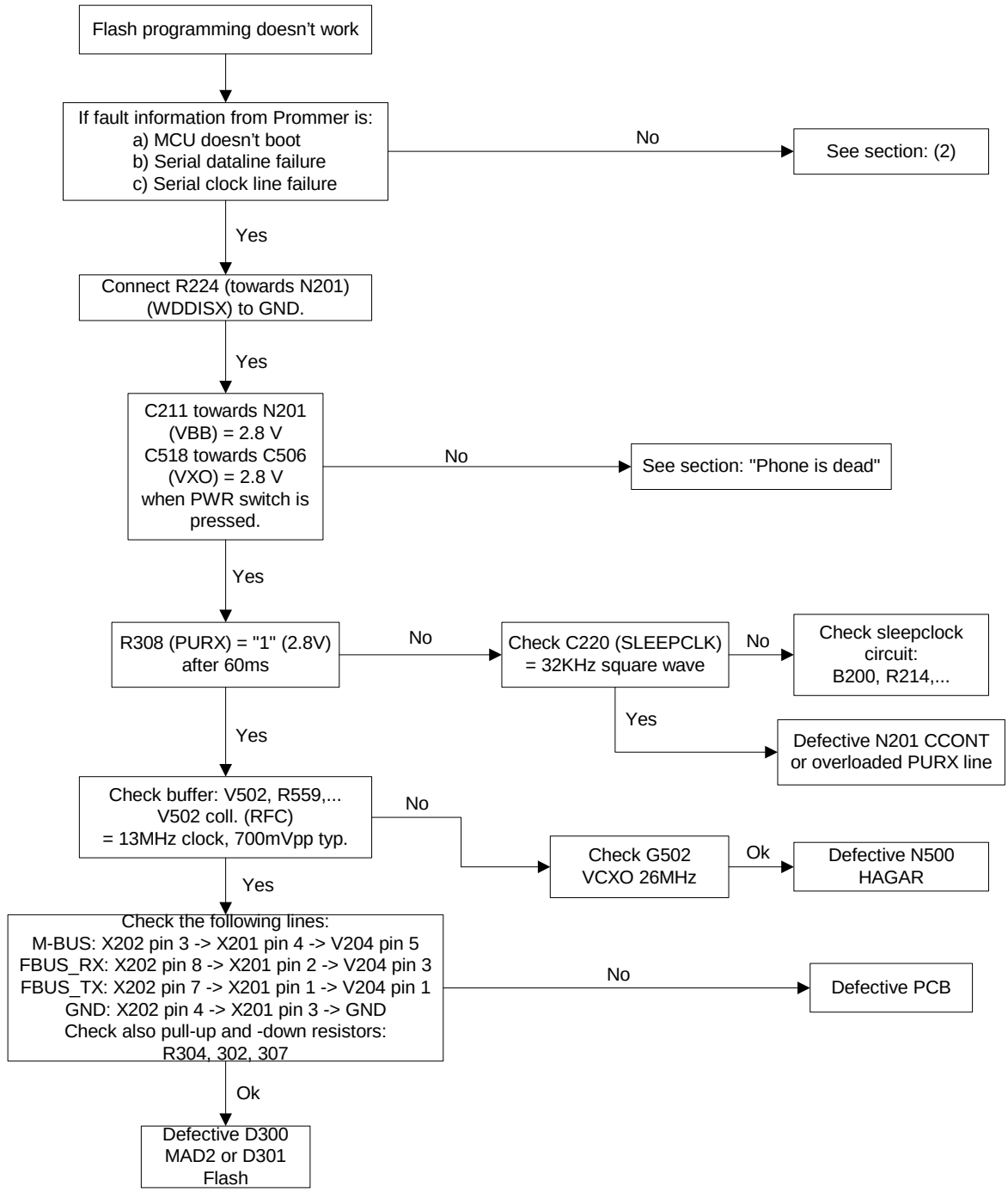
- Flash programming voltage is produced in a different way (external Vpp in FLALI).Signal routings are different.
- In case of a flash programming error the prommer box is able to give some information on the error that has occurred.

©Nokia Mobile Phones Ltd.

- The error information could be :
- MCU does not boot
- Serial clock line failure
- Serial data line failure
- External RAM failiure
- Algorithm file or alias ID not found
- MCU flash Vpp error

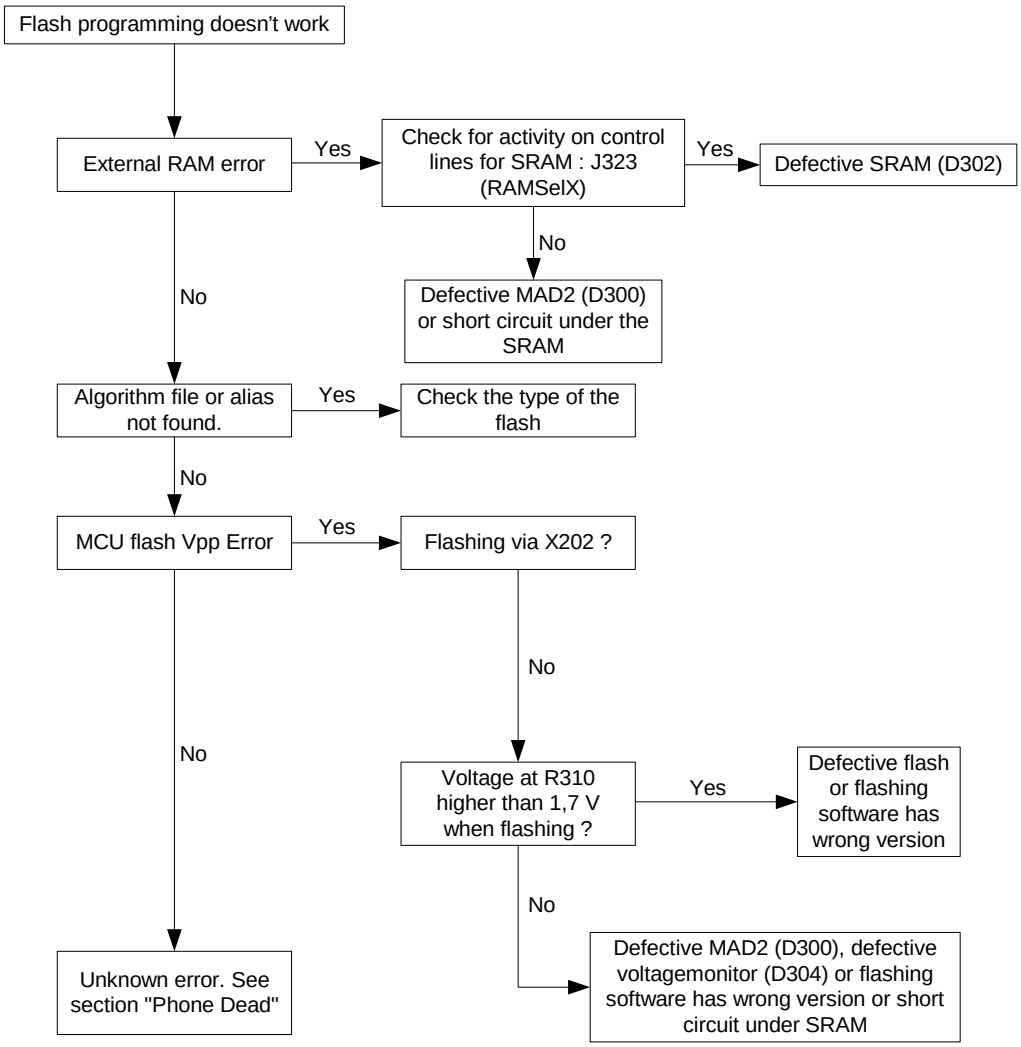
Because of the use of ìBGA components it is not possible to verify if there is a short-circuit in any of the lines to and from the MAD2WD1 and the SRAM/flash circuits.
The faultfinding diagrams for flash programming are shown overleaf.

2.1 Flash programming diagram (1)



©Nokia Mobile Phones Ltd.

2.2 Flash programming diagram (2)

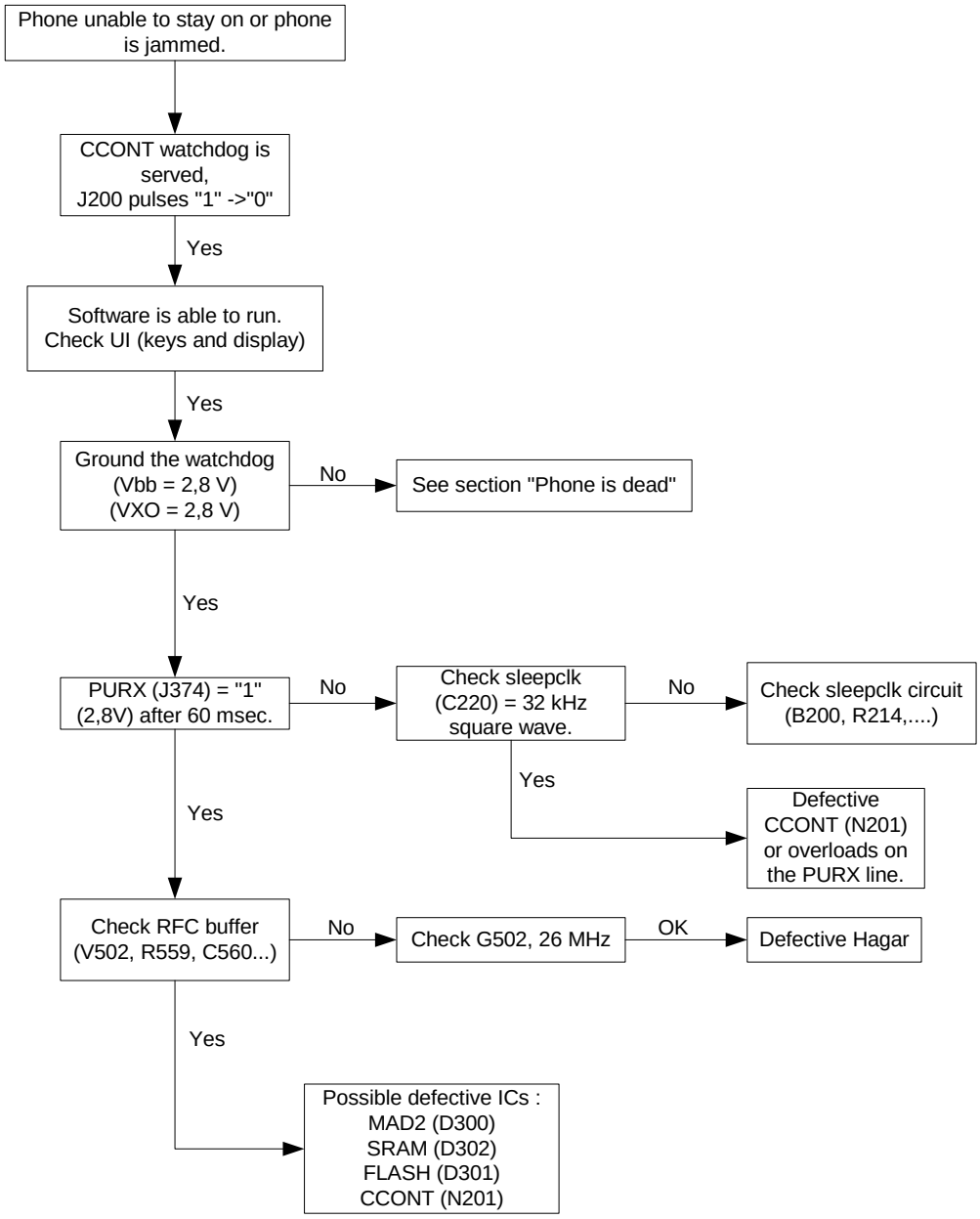

Flash programming doesn't work
External RAM error
Yes
Check for activity on control lines for SRAM : J323 (RAMSelX)
Yes
Defective SRAM (D302)
No
Defective MAD2 (D300) or short circuit under the SRAM
No
Algorithm file or alias not found.
Yes
Check the type of the flash
No
MCU flash Vpp Error
Yes
Flashing via X202 ?
No
No
Voltage at R310 higher than 1,7 V when flashing ?
Yes
Defective flash or flashing software has wrong version
No
Defective MAD2 (D300), defective voltagemonitor (D304) or flashing software has wrong version or short circuit under SRAM
Unknown error. See section "Phone Dead"

3. Phone Stays On or is Jammed

If this kind of error occurs after flashing the most plausible reason is open pins on an IC.

Normally the CCONT will power the phone down after 30 seconds if the watchdog has not been served by SW. Connecting an oscilloscope to J200 (DataSelX on the CCONT) can monitor the watchdog updating. Normally there is a short pulse from 1 to 0 every 8 seconds. Grounding J200 can disable the power off function.

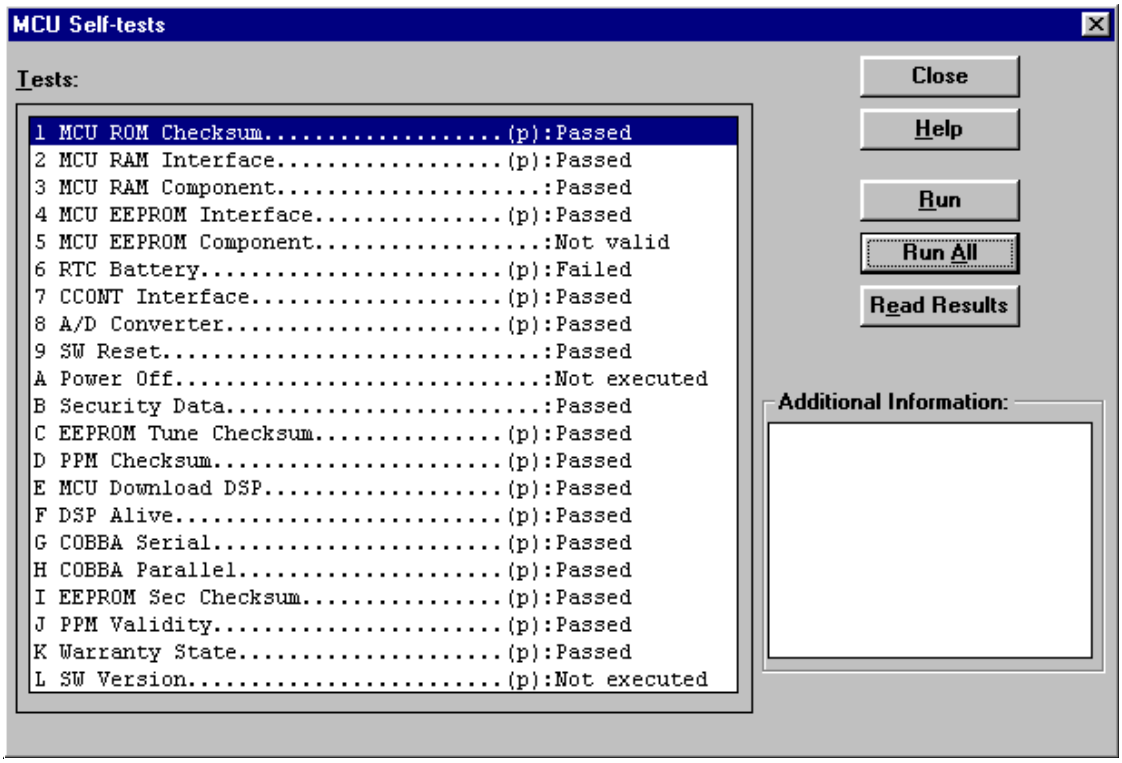
3.1 Fault finding diagram.


Phone unable to stay on or phone is jammed.
CCONT watchdog is served, J200 pulses "1" ->"0"
Yes
Software is able to run. Check UI (keys and display)
Yes
Ground the watchdog (Vbb = 2,8 V) (VXO = 2,8 V)
No
See section "Phone is dead"
Yes
PURX (J374) = "1" (2,8V) after 60 msec.
No
Check sleepclk (C220) = 32 kHz square wave.
No
Check sleepclk circuit (B200, R214,....)
Yes
Defective CCONT (N201) or overloads on the PURX line.
Yes
Check RFC buffer (V502, R559, C560...)
No
Check G502, 26 MHz
OK
Defective Hagar
Yes
Possible defective ICs : MAD2 (D300) SRAM (D302) FLASH (D301) CCONT (N201)

4. Display Information : "Contact Service"

If the message "Contact Service" is displayed one or more parts of the software is unable to execute properly. At the same time, the watchdog is triggered and is thereby able to tell if an error has occurred. Selftest functions are executed when the phone is powered on and if one or more selftest functions fails, the message "Contact Service" is shown in the display.

MCU selftest cases can be split into two categories : the ones that are executed during power up and the ones that are executed only with a PC connected. These test and the items included are as follows :



5. No Network Found, No Call Established

When the phone is unable to either find a network or establish a call, both the RF part and the baseband part can cause it. The phone can be set to required mode (RF measurements) by the WinTesla service software in order to determine if the error is placed either in the RF part or the baseband part.

There are two circuits that supplies the RF part of the phone. These circuits are :

MAD2WD1 (D300)

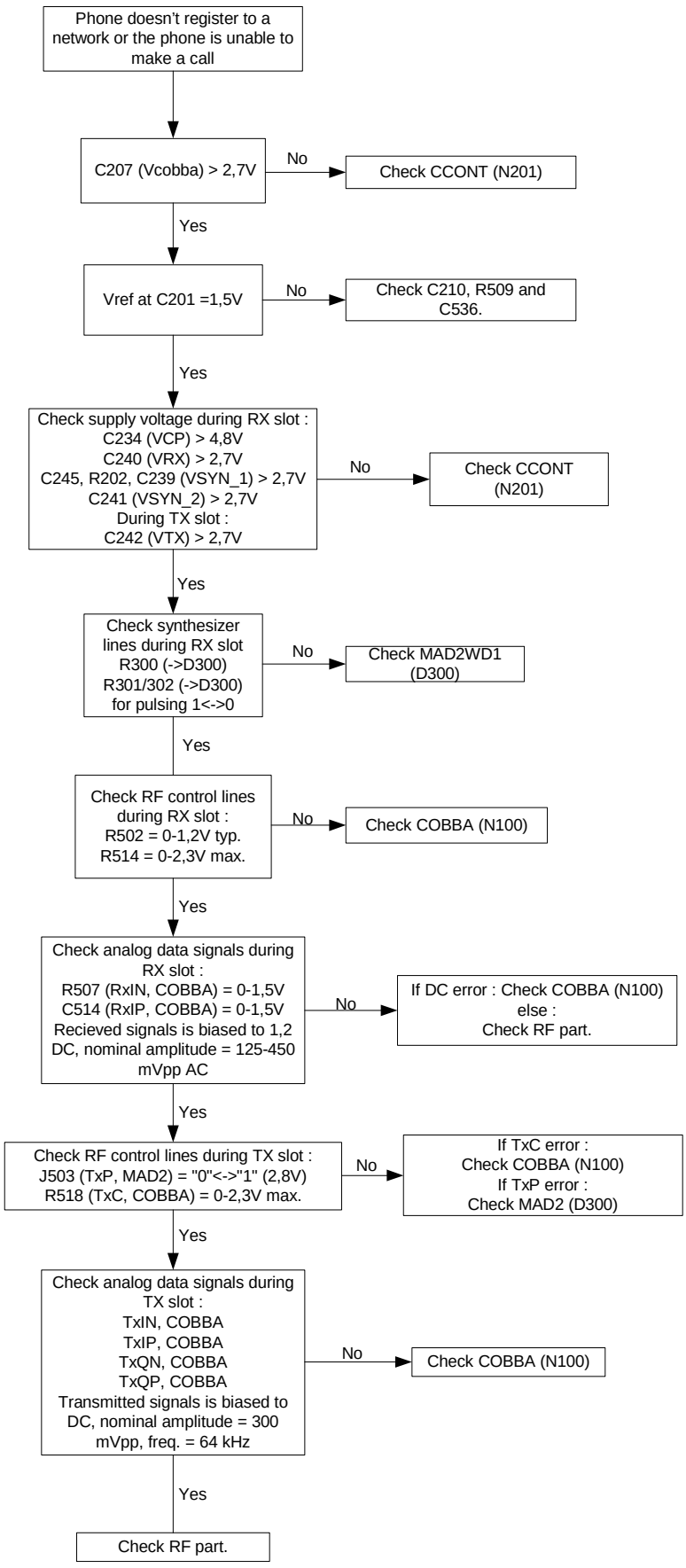
COBBA (N100)

The MAD2WD1 circuit supplies the RF part with the digital control signals : SynthEna, TxP, etc. and the COBBA supplies the RF part with the analog control signals : AFC, TxC etc

After power up, DSP indicates all the completed functions by changing the state of the XF pin as shown below.

©Nokia Mobile Phones Ltd.

6. Phone Not Registering to a Network

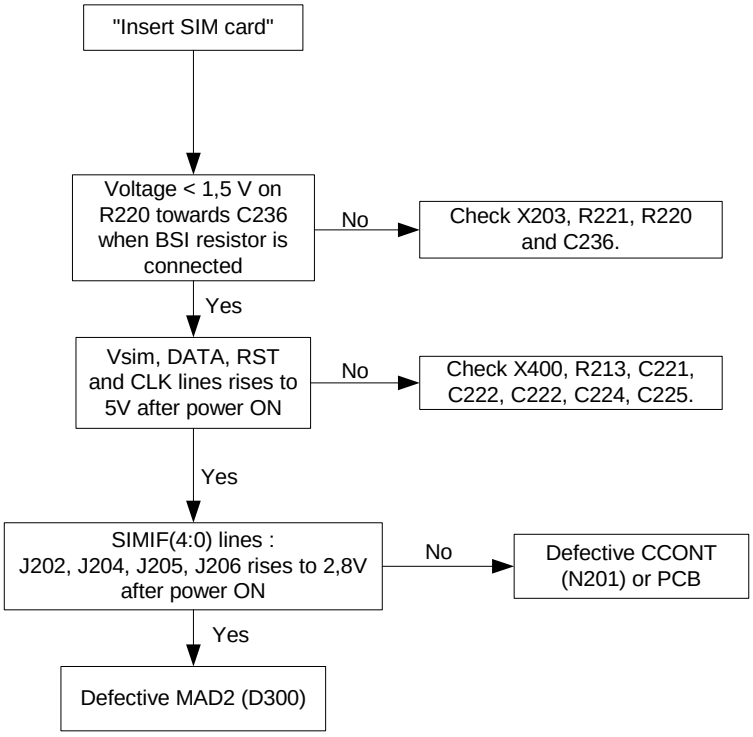


7. Sim Related Errors

The SIM interface from the MAD2WD1 (D300) to the SIM connector (X400) can be tested without a SIM card. When the power is switched on and the BSI terminal is grounded by a resistor, all interface lines (VSIM, DATA_A, SIMRST_A, SIMCLK) rises, first to 3V the to 5V. This is repeated four times. In this way it is possible to find errors in the SIM interface without a SIM card.

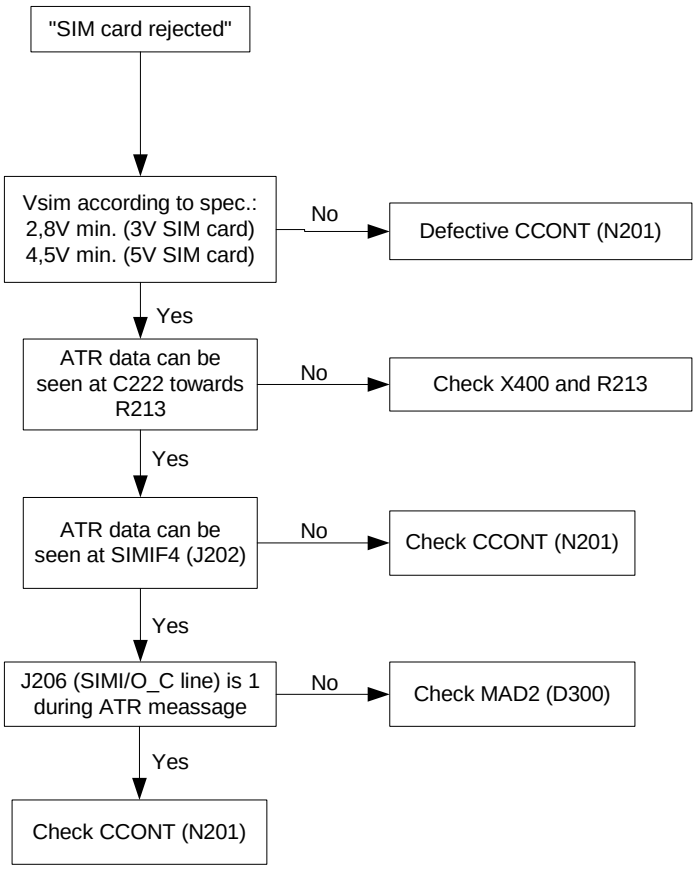
In case of a "SIM card rejected" error, the ATR message is actually sent from the SIM card but it is somehow corrupted, the data signal levels are out of spec. or the factory set values is incorrect (SIM locks etc.).

7.1 "Insert SIM card" error


"Insert SIM card"
Voltage < 1,5 V on R220 towards C236 when BSI resistor is connected
No
Check X203, R221, R220 and C236.
Yes
Vsim, DATA, RST and CLK lines rises to 5V after power ON
No
Check X400, R213, C221, C222, C222, C224, C225.
Yes
SIMIF(4:0) lines : J202, J204, J205, J206 rises to 2,8V after power ON
No
Defective CCONT (N201) or PCB
Yes
Defective MAD2 (D300)

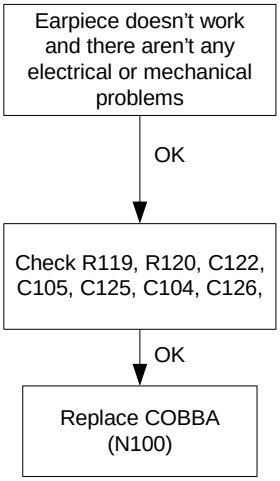
©Nokia Mobile Phones Ltd.

7.2 "SIM card rejected" error

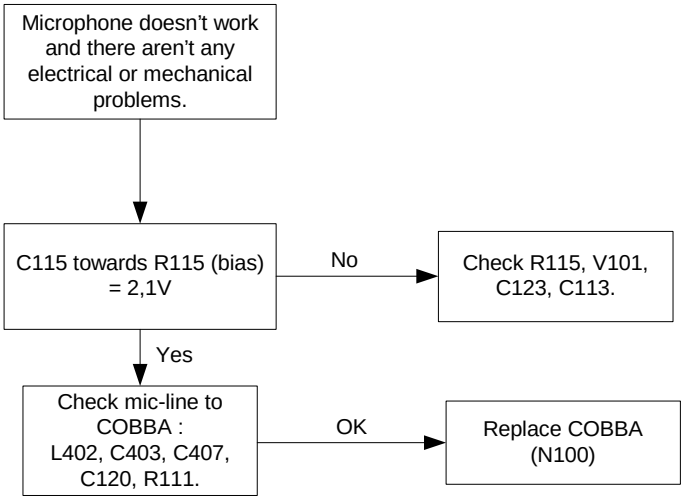


8. Audio Faults

8.1 Internal earpeace

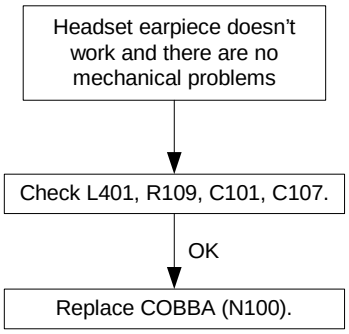

Earpiece doesn't work and there aren't any electrical or mechanical problems
OK
Check R119, R120, C122, C105, C125, C104, C126,
OK
Replace COBBA (N100)

8.2 Internal microphone

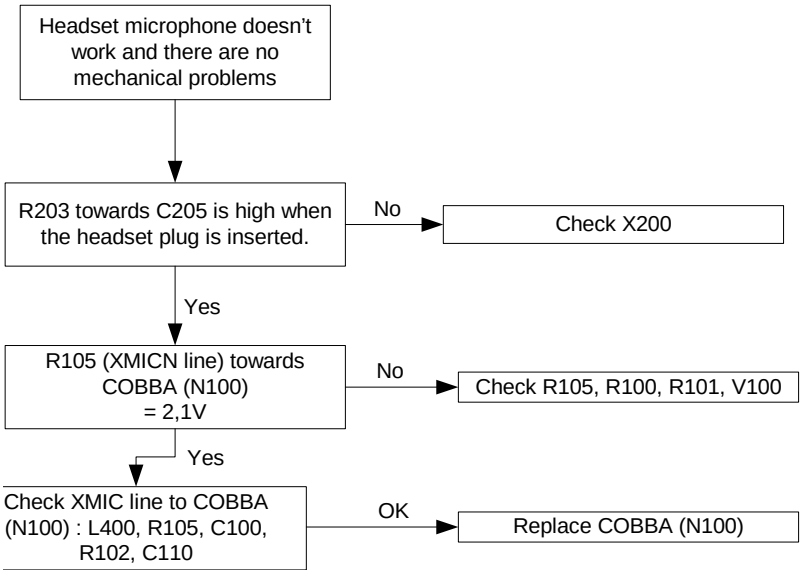

Microphone doesn't work and there aren't any electrical or mechanical problems.
C115 towards R115 (bias) = 2,1V
No
Check R115, V101, C123, C113.
Yes
Check mic-line to COBBA : L402, C403, C407, C120, R111.
OK
Replace COBBA (N100)

©Nokia Mobile Phones Ltd.

8.3 External earpeace

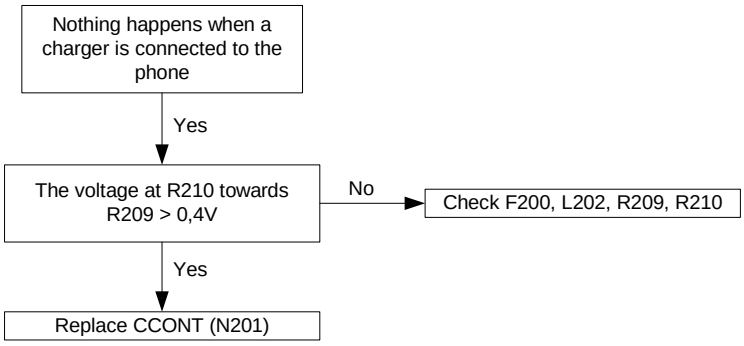


8.4 External microphone

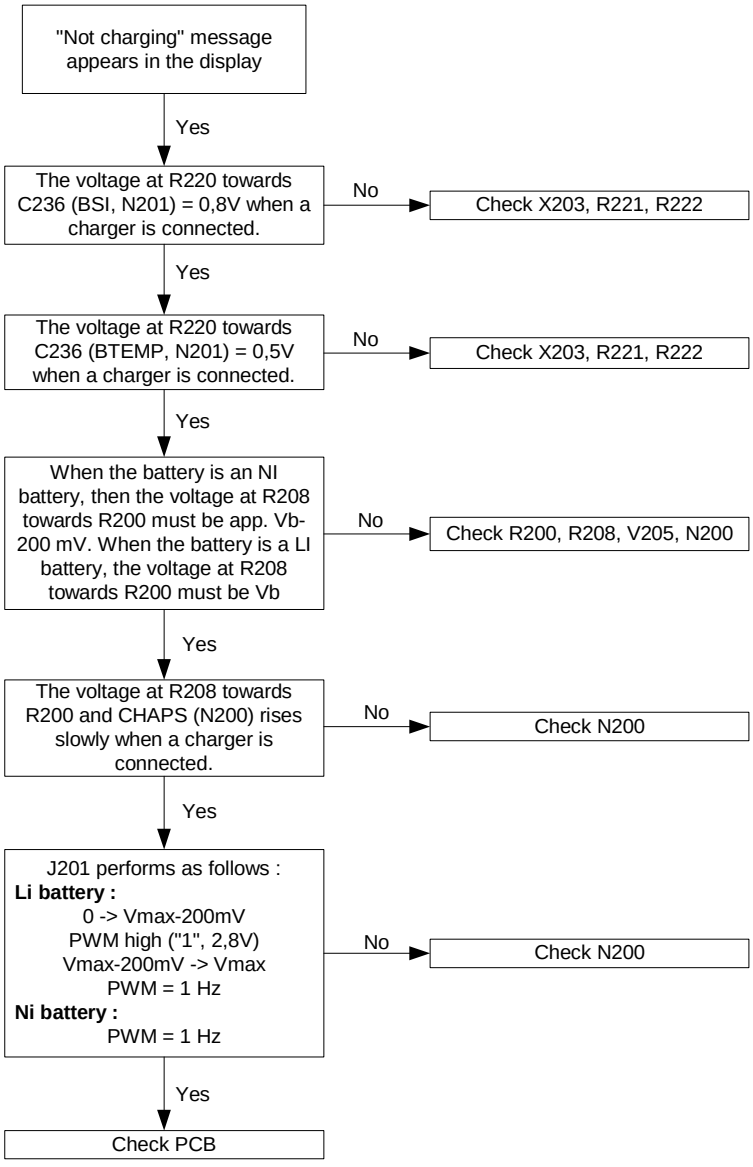

Headset microphone doesn't work and there are no mechanical problems
R203 towards C205 is high when the headset plug is inserted.
No
Check X200
Yes
R105 (XMICN line) towards COBBA (N100) = 2,1V
No
Check R105, R100, R101, V100
Yes
Check XMIC line to COBBA (N100) : L400, R105, C100, R102, C110
OK
Replace COBBA (N100)

9. Charging Error

9.1 No detection of charger


Nothing happens when a charger is connected to the phone
Yes
The voltage at R210 towards R209 > 0,4V
No
Check F200, L202, R209, R210
Yes
Replace CCONT (N201)

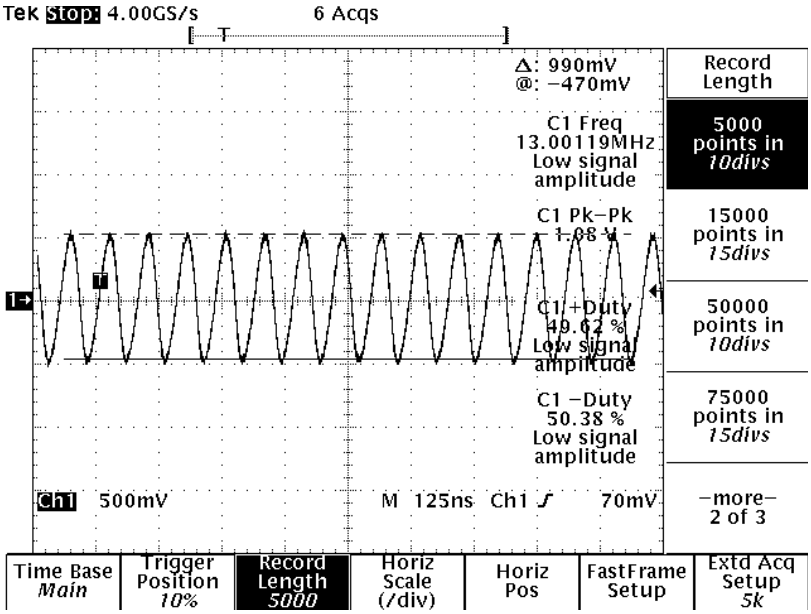
9.2 "Not Charging" message


"Not charging" message appears in the display
Yes
The voltage at R220 towards C236 (BSI, N201) = 0,8V when a charger is connected.
No
Check X203, R221, R222
Yes
The voltage at R220 towards C236 (BTEMP, N201) = 0,5V when a charger is connected.
No
Check X203, R221, R222
Yes
When the battery is an NI battery, then the voltage at R208 towards R200 must be app. Vb-200 mV. When the battery is a LI battery, the voltage at R208 towards R200 must be Vb
No
Check R200, R208, V205, N200
Yes
The voltage at R208 towards R200 and CHAPS (N200) rises slowly when a charger is connected.
No
Check N200
Yes
J201 performs as follows :
Li battery :
0 -> Vmax-200mV
PWM high ("1", 2,8V)
Vmax-200mV -> Vmax
PWM = 1 Hz
Ni battery :
PWM = 1 Hz
No
Check N200
Yes
Check PCB

Baseband Plots

©Nokia Mobile Phones Ltd.

Plot1: RFC in Normal Operation



CH-1 RFC (C203)

Requirements:

Clock frequency: 13 MHz +/- 20 PPM (25 °C)

Clock amplitude: 0.5 Vpp .. 2.0 Vpp

Duty-cycle : 50% +/- 5%

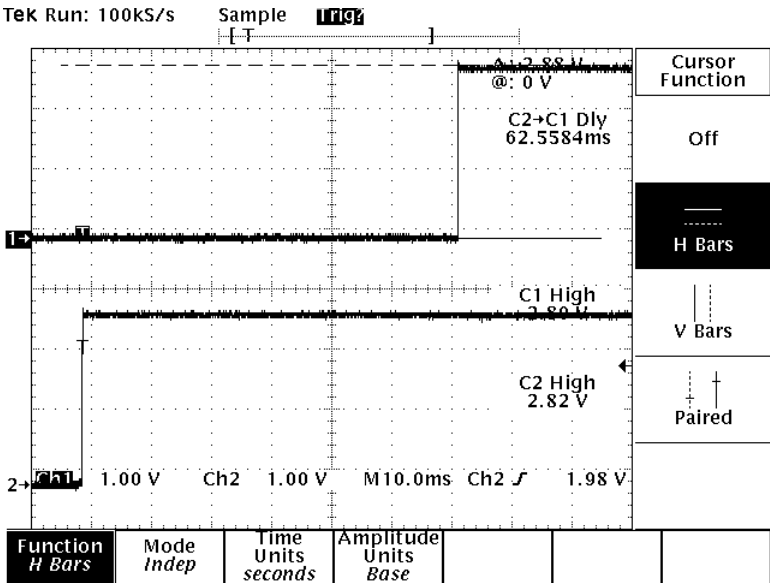
Performed measurements:

Clock frequency: 13.00119 MHz (25 °C)Pass

Clock amplitude: 1.08 Vpp Pass

Duty-cycle : 49.62%, -50.38%Pass

Plot 2: Power Up with ACP-7U



CH-1: PURX (J212)CH-2: VCXOPWR (J308)

Requirements:

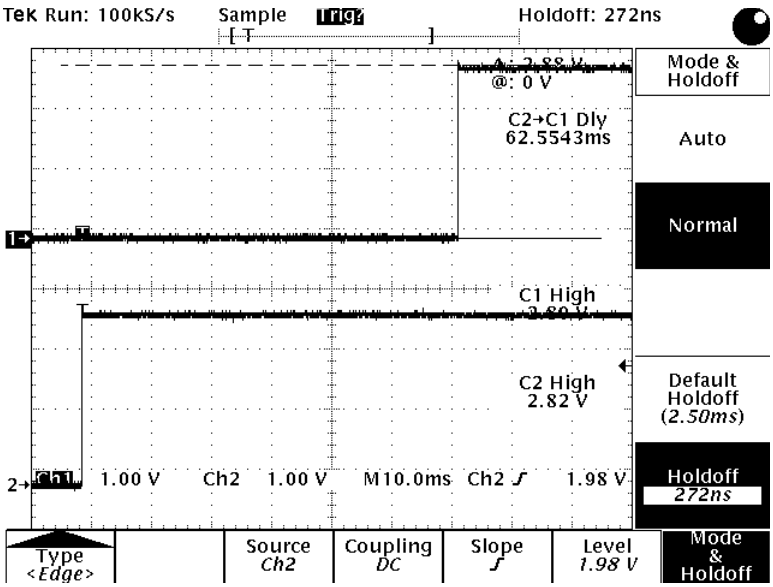
The phone must power-on properly with charger ACP7-U. VCXOpwr signal at the MAD is used as trigger. PURX is monitored by the scope. PURX signal must go high after 62 ms ± 20%.

Performed measurements:

Power up with ACP-7U		
Delay: 62.5584ms	PURX Level: 2.82V	PASS

©Nokia Mobile Phones Ltd.

Plot 3: Power up with ACP-8U



CH-1: PURX (J212)CH-2: VCXOPWR (J308)

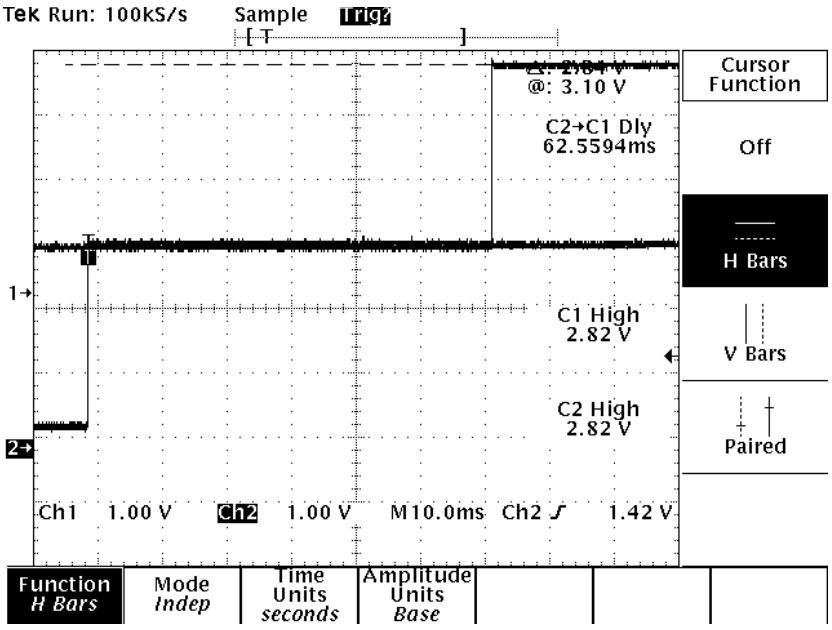
Requirements:

The phone must power-on properly with charger ACP8-U. VCXOpwr signal at the MAD is used as trigger. PURX is monitored by the scope. PURX signal must go high after 62 ms ± 20%.

Performed measurements:

Power up with ACP-8U		
Delay: 62.5543ms	PURX Level: 2.82V	PASS

Plot 4: Power up with ACP-9U



CH-1: PURX (J212)CH-2: VCXOPWR (J308)

Requirements:

The phone must power-on properly with charger ACP9-U. VCXOpwr signal at the MAD is used as trigger. PURX is monitored by the scope. PURX signal must go high after 62 ms ± 20%.

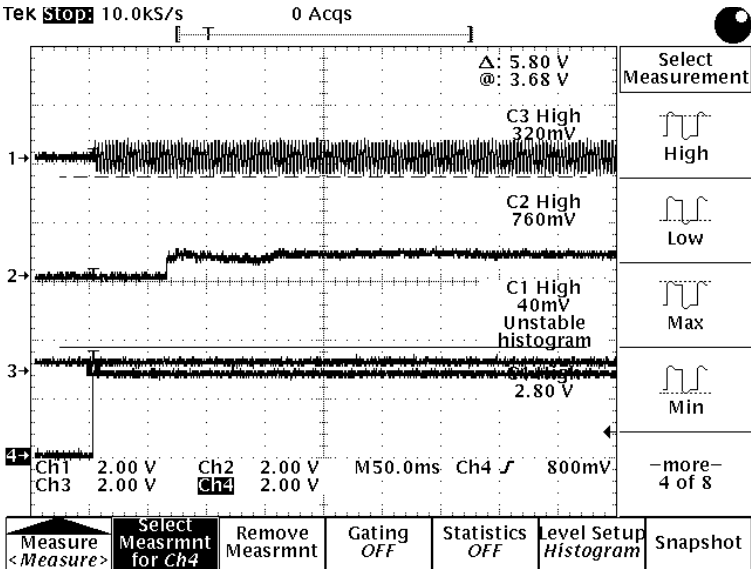
Performed measurements:

Power up with ACP-9U		
Delay: 62.5594ms	PURX Level: 2.82V	PASS

©Nokia Mobile Phones Ltd.

Plot 5:Power up with a power variable power supply

Purpose of this test is to verify that power-up sequence is following specifications regarding the V_{char} detection circuit.



CH1: RFCLK (C303)Ch2: PURX (J212)

CH3: VCHAR (R210)CH4: VBB (C209)

Requirements:

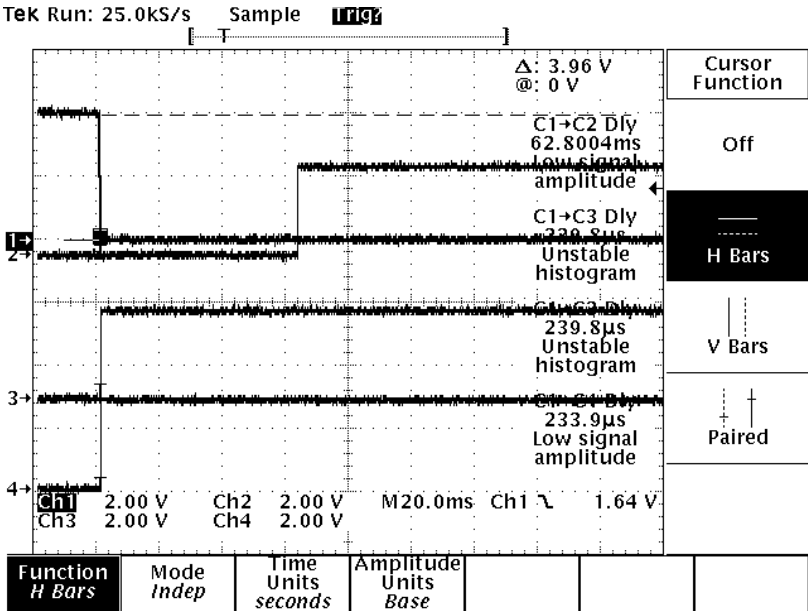
The V_{CHAR} detection criteria: 200... 400 mV.

Performed measurements:

Power up with a power variable power supply		
VCHAR Level :	320mV	Pass

Plot 6: Power up with Power switch (PWRONx)

Purpose of this test is to verify correct power-up sequence by pressing the power switch.



CH1: PwrOnx (R224)Ch2: PURX (J212)

CH3: VXO Supply (R519)CH4: VBB (C209)

Requirements:

The phone must power properly up when the power switch is pressed.

PwrOnX is used as trigger. PURX is monitored by the scope. PURX signal must go high after 62 ms ± 20%. PwrOnX must still be low after the PURX signal has gone high.

Performed measurements:

Power up when power switch is pressed		
Delay (PwrOnx -> PURX):	62.8004 ms	Pass
Delay (PwrOnx -> VXO Supply):	239.8 us	Pass

©Nokia Mobile Phones Ltd.

Plots 7,8,9,10: PCM Clock Tests

The purpose of this test is to verify that the timing of the PCM bus is according to the MAD2WD1/COBBA specifications.

A digital oscilloscope is triggered from the rising edge of PCM clock. The other channels are connected to the PCM sync clock, PCMTx and PCMRx. The phone is connected to a GSM tester and a call is established. Times between different signals are measured and the results are stored.

Requirements:

Plot 7. PCMSclk vaild after PCMDclk rising delay Td(SCL) : 0 .. 8 ns

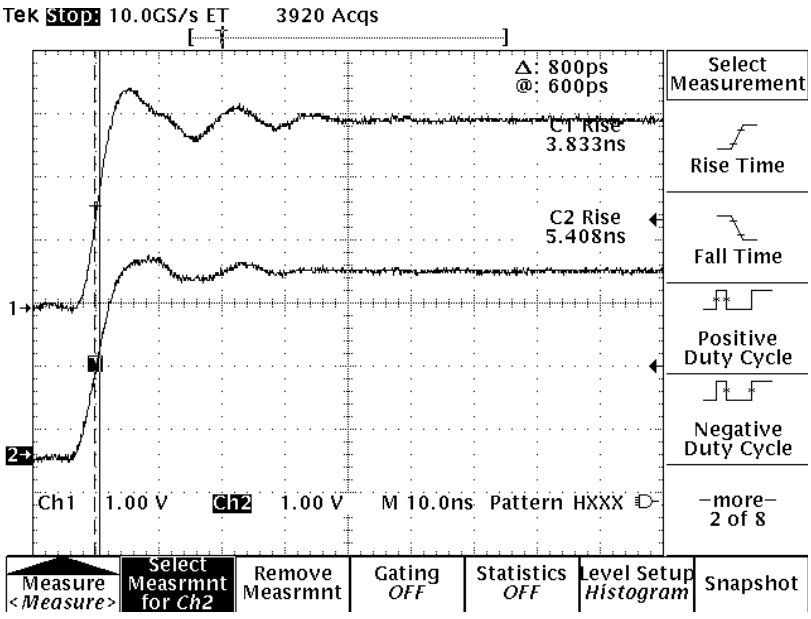
Plot 8. PCMTxData vaild after PCMDclk rising delay Td(PCMTxData) : 5 .. 25 ns

Plot 9. PCMRxData setup time before PCMDclk falling edge Tsu(PCMRxData) : 20 ns .. T_{cycle}-20 ns

Plot 10. PCMRxData hold time after PCMDclk falling adge Th(PCMRxData) : 20 ns .. T_{cycle}-20 ns where T_{cycle} = TBA.

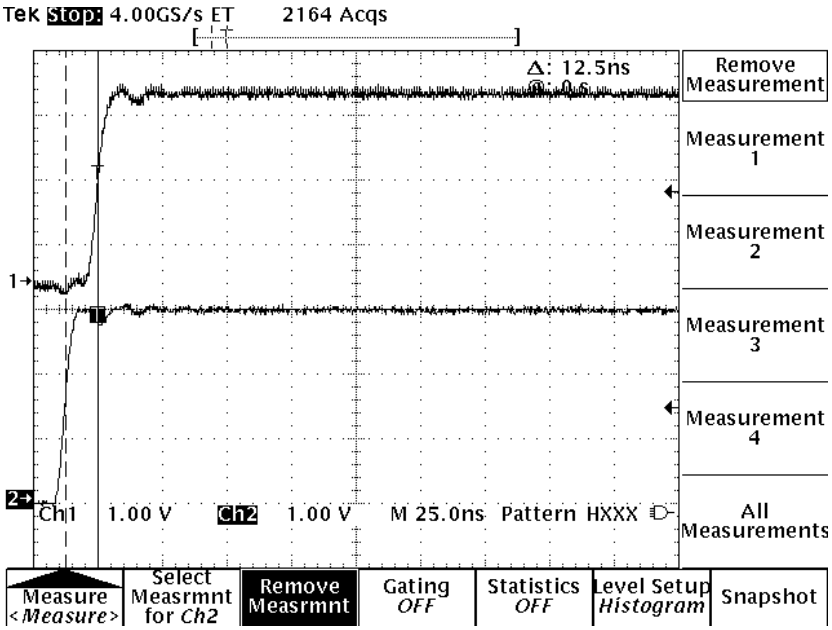
Performed Measurements:

Plot 7: PCMSclk vaild after PCMDclk rising delay Td(SCL) : 600ps - Pass



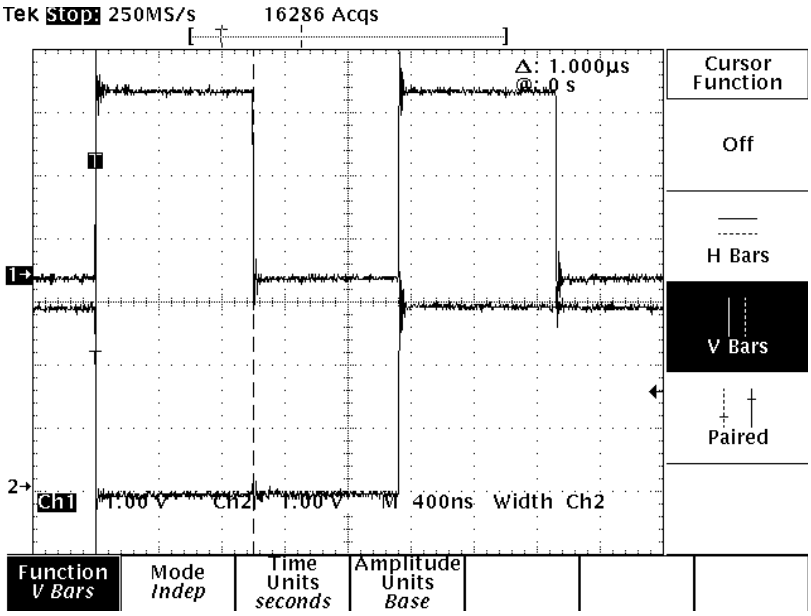
CH1 – PCMSCLK (J307)CH2 – PCMDCLK (J306)

Plot 8: PCMTxData vaild after PCMDclk rising delay Td(PCMTxData): 12.5ns - Pass



CH1 – PCMTxData (J309)CH2 – PCMDCLK(J306)

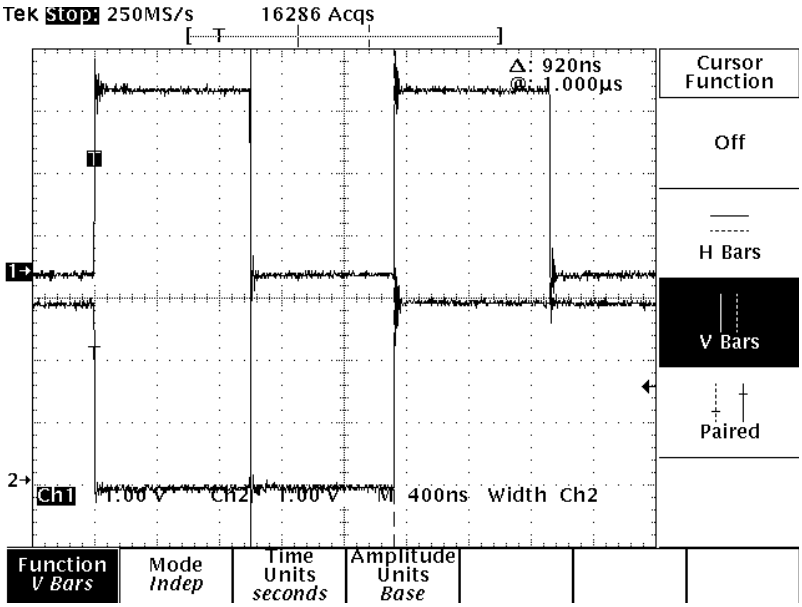
PLot 9: PCMRxData setup time before PCMDclk falling edge Tsu(PCMRxData) : 1us - Pass



CH1 – PCMDCLK (J306)CH2 – PCMRxData (J305)

©Nokia Mobile Phones Ltd.

Plot 10: PCMRxData hold time after PCMDclk falling adge Th(PCMRxData) : 920ns - Pass



CH1 – PCMDCLK (J306)CH2 – PCMRxData (J305)

RF Troubleshooting

Introduction

This section is written for use in conjunction with the WinTesla tuning and testing software. Pictures of the menu structures are shown through out the document. This should be used along with the phone's RF schematic.

WinTesla has 3 key menus:

Product -this is for the product special settings. (see below)

Testing -this menu allows switching on the phone in different modes

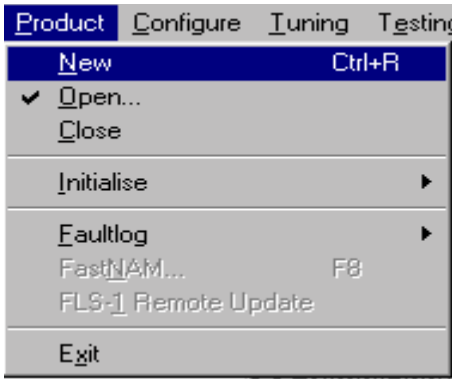
Tuning -this menu allows tuning and storing of data to eeprom

The phone's schematics (*System Module* chapter) are essential for trouble shooting and are referred to in detail throughout this document. The schematics include an "RF Test Points" diagram for further reference.

Basic Controls with Wintesla

Selecting the Phone and the Operating Band

Following connection of the phone to the PC COM port and starting WinTesla. Select "Product" and "New" and HDa52 configuration will automatically be selected.

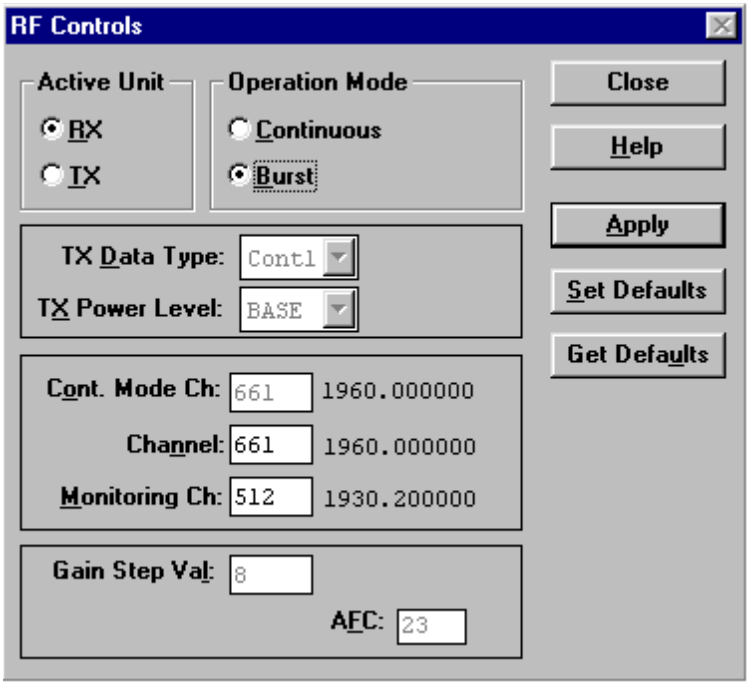


©Nokia Mobile Phones Ltd.

RF Controls

RF controls window is used to control the different RF modes. This RF Control window can be started from the Testing Menu.

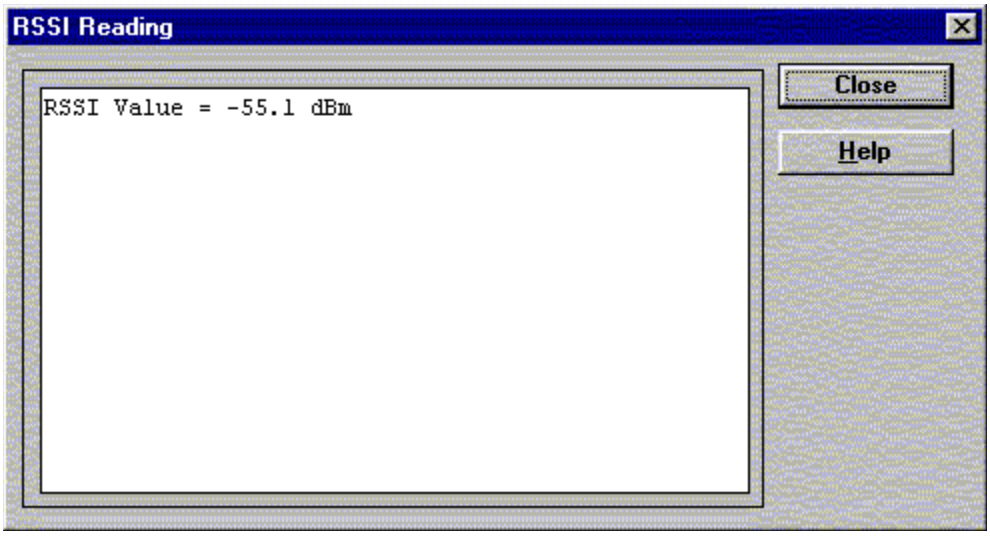
With "RF controls"menu selected, all modes for RF testing, can be switched on.



"RSSI reading" window can be used to test AGC calibration by checking the Received Signal

Strength measured by the phone.

Note the channel used by the phone can be found in the "RF Information "window. The channel can be changed by using the "RF controls" window.



Tuning the Phone

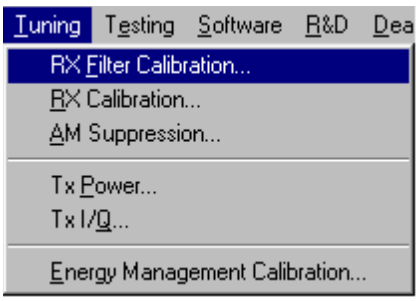
RX Tuning

RX BB Filter calibration

Equipment: - No external equipment needed

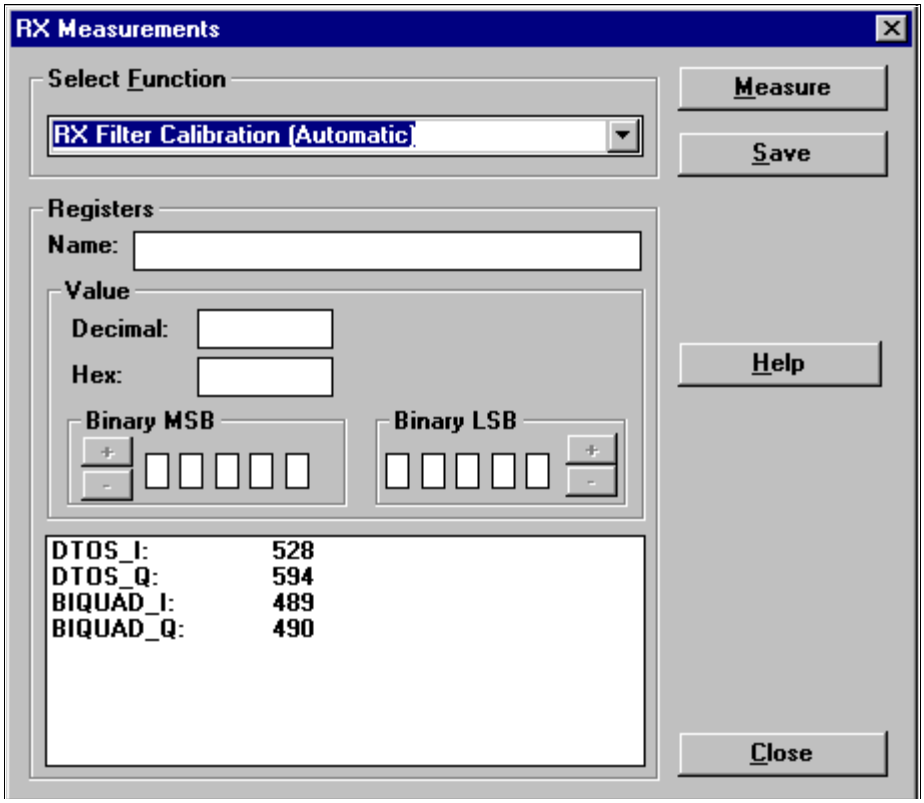
Tuning procedure

Select Tuning, RX Filter calibration from WinTesla



©Nokia Mobile Phones Ltd.

Click "Measure" RX channel filter will be calibrated.



No external signals are needed for this tuning. All signals are generated in the baseband and switched back from TX to RX inside Hagar

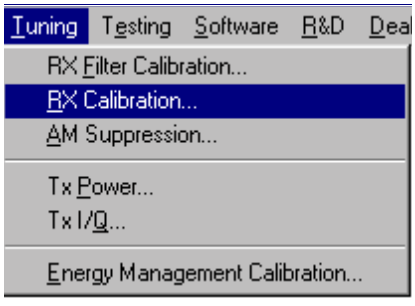
VCTCXO frequency (AFC) & RX RSSI (AGC) Calibration

Note:Frequencies of the provided signals can differ, depending the channel used. Information of the needed signal is given from the tuning function of WinTesla

Equipment: - RF generator, CW mode

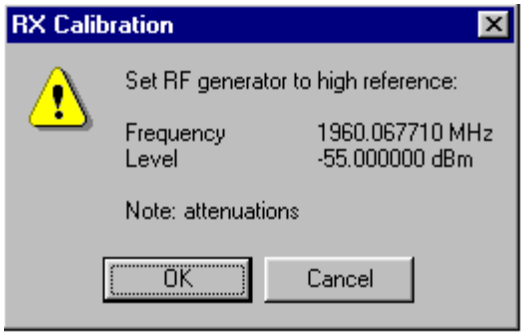
Tuning procedure

Select Tuning, RX-Calibration from WinTesla



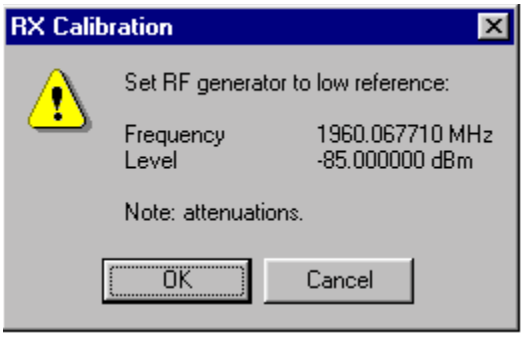
©Nokia Mobile Phones Ltd

Feed GSM1900 signal at hi level in to the antenna port



Select OK to tune GSM1900 high level

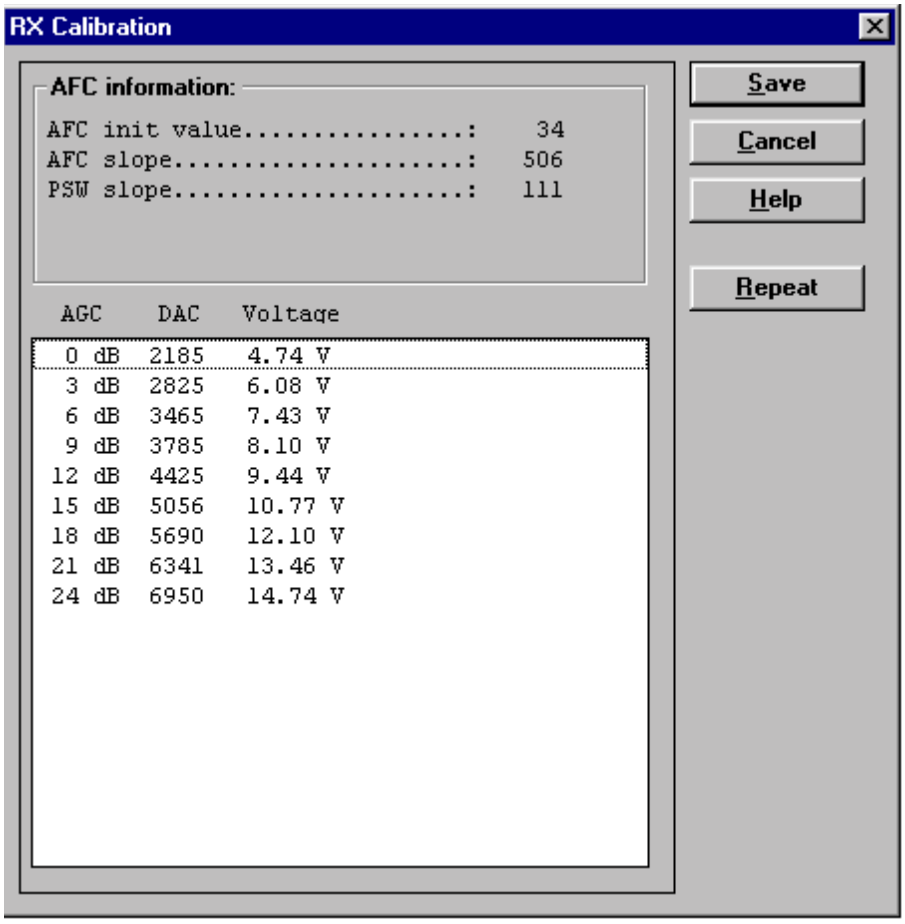
Feed GSM1900 signal at lo level in to the antenna port



Select OK to tune GSM1900 low

©Nokia Mobile Phones Ltd.

Tuning SW shows the tuning values for GSM1900 RX calibration



Select SAVE to save the tuning values

©Nokia Mobile Phones Ltd

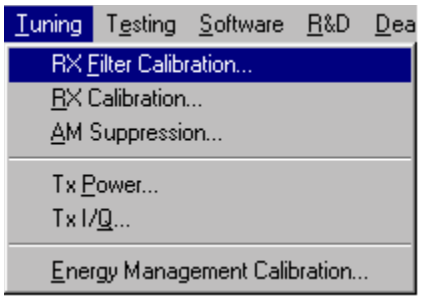
AM Suppression Calibration

Note:Frequencies of the provided signals can differ, depending the channel used. Information of the needed signal is given from the tuning function of WinTesla

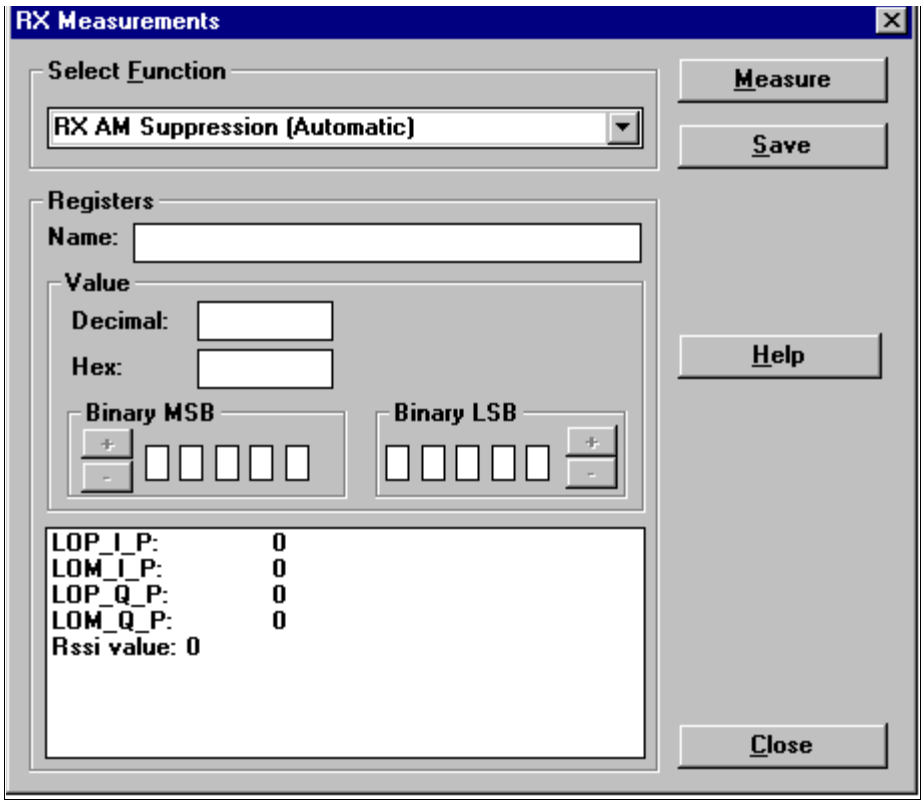
Equipment: - RF generator with AM modulation

Tuning procedure

select "Tuning" then select, "AM-Suppression (Automatic)" connect RF generator to the phone and click "Measure".



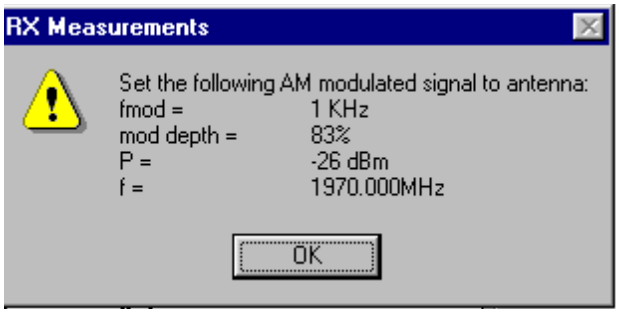
Select Function RX AM Suppression automatic, connect RC Generator to phone and Click Measure.



©Nokia Mobile Phones Ltd.

Set RF Generator with the following signal:

f = 1970 MHz
P = -26 dBm
f mod= 1 kHz
modulation depth = 83%



Click OK, and AM Suppression will be calibrated

©Nokia Mobile Phones Ltd

TX Tuning

Note: If you use Jig MJS-19 to tune power, adjust target values based on attenuation of thr jig and cable.

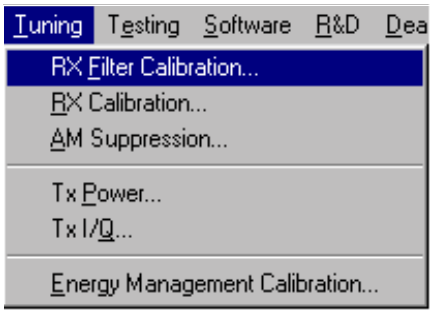
TX Power Tuning

Frequencies: Depends on the channel and frequency band used during the tuning.
GSM1900 center channel is (661), 1880 MHz
Used channel can be seen in *Quick RF Info –window.*
If this window is not shown it can be turned on by the command *View, Quick RF Info.*

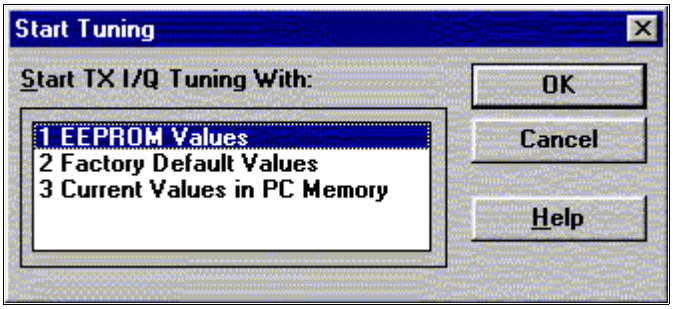
Equipment: Spectrum analyzer, WinTesla

Tuning procedure

Start TX Power tuning

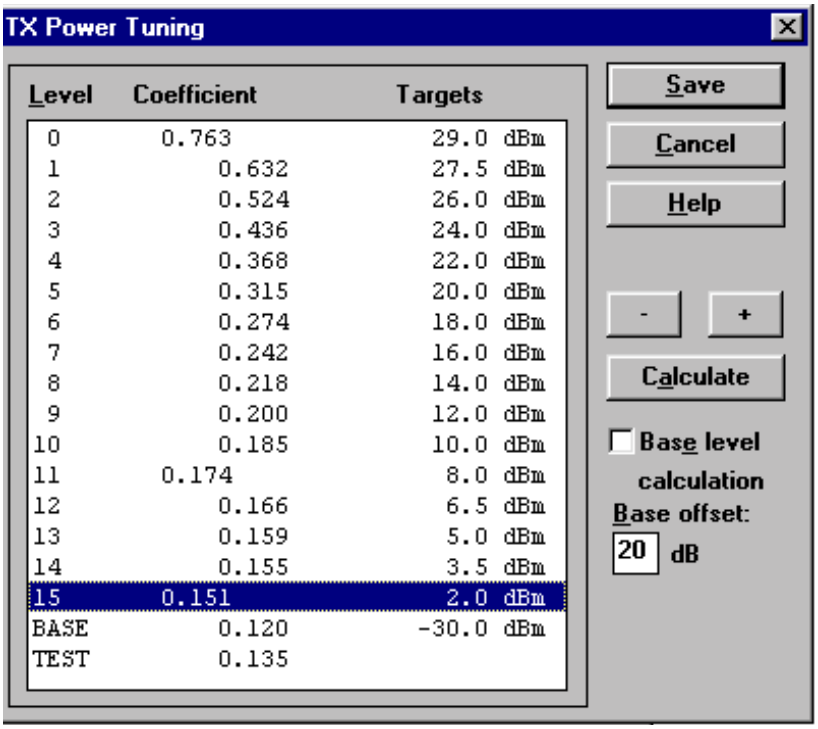


Select initial values from EEPROM



©Nokia Mobile Phones Ltd.

In tuning window select highest power level 0



To get a clear display set spectrum analyzer as follows:

–frequency	1880 MHz (depend the used ch)
-span	0 Hz
-resolution bw	3 MHz
-video bw	3 MHz
-sweep time	10 ms

Tune highest power level to 29 dBm

Select power level 11

Tune power level to 8 dBm

Select lowest power level

Tune lowest power level to 2 dBm

Press calculate button to calculate other power levels.

Save power level calibration results by pressing Save button.

©Nokia Mobile Phones Ltd

TX IQ Tuning

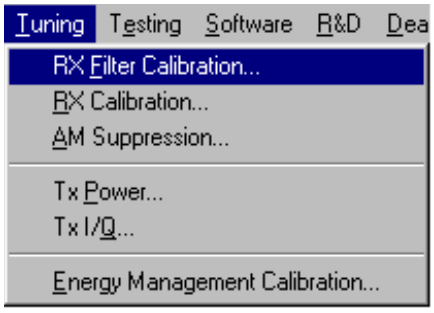
Frequencies: Depending of the channel used during the tuning.
GSM1900 center channel (661),1880 MHz
used channel can be seen in *Quick RF Info –window.*
If this window is not shown it can be turned on by the command *View, Quick RF Info.*

Equipment: Spectrum analyzer

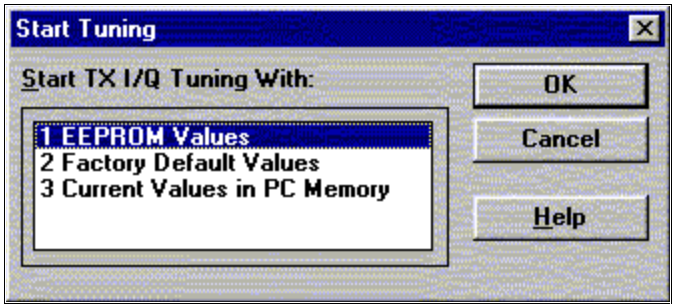
Procedure

Start TX IQ tuning

Tuning, TX IQ Tuning



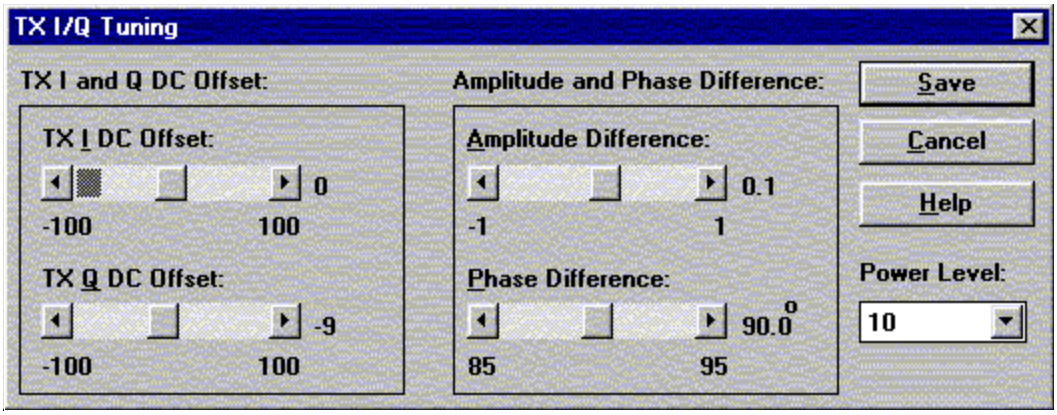
Select initial values from EEPROM



©Nokia Mobile Phones Ltd.

To get a clear display set spectrum analyzer as follows

-frequency 1880 MHz (depend the used ch)
-span 200 kHz
-resolution BW10 kHz
-video BW1 kHz
-sweep time 1s



Use TX I DC offset & TX Q DC offset controls to minimize the carrier leakage

Use Amplitude difference & Phase difference controls to improve sideband suppression.

Select Save to save tuning values to EEPROM

©Nokia Mobile Phones Ltd

Receiver Fault Finding

General

Middle channel 661 is used as a test channel. Signal level in the RF generator is set to –50 dBm. Signal levels and waveforms are shown in the *RF testpoints* section. Signal levels can vary depending on the measurement method.

> ***Note:*** *The recommended way to make your own measurements is to use a known good phone and make a suitable reference level table.*

Hagar

AGC-block

AGC-block is inside HAGAR. AGC block can be tested by measuring the IQ signals with the oscilloscope. IQ signals in RF/BB interface can be measured at points RX1 and RX2 . See "RF Testpoints" on page 47.

Point RX1 is after the AGC stage. From here the effect of gain steps (3 ... 8) can be seen. For the basic waveform of the signal See "Plot 1. RX I/Q from Hagar to baseband" on page 52.

Point RX2 is before AGC stage and only LNA gain step (2 ... 3) is available in this point. For the basic form of the signal See "Plot 2. RX I/Q before AGC" on page 52.

Controlling AGC with WinTesla

When continuous RX mode is used, AGC gain step can be selected by entering gain step number into the AGC Absolute text box See "RF Controls" on page 33. When burst mode is used in RX AGC is automatically adjusted by the system.

In burst mode the signal level in point RX1 should keep its level when the RF signal level is adjusted in the limit of AGC dynamic range.

LNA

LNA operation can be checked by measuring the signal level from points RX 11 using the spectrum analyzer. LNA gain step can also be tested from point RX2 by oscilloscope. See "Plot 3. LNA control" on page 53.

RX-filters

RX-filters can be checked by measuring the signal level from points RX11 and RX13.

Most of the problems with these saw filtesr is the linearity over the frequency band. The measurement should include some edge channels.

©Nokia Mobile Phones Ltd.

Antenna Switch

Antenna switch operation can be tested by measuring the signal level from point RX13 with the spectrum analyzer.

Antenna switch RX path is on all the time except during the TX burst.

Transmitter Fault Finding

General

Middle channel 661 is used as a test channel (1880 MHz). Signal levels can vary depending on the measurement method.

> ***Note:*** *The recommended way to make your own measurements is to use a known good phone and make a suitable reference level table.*

Set the wanted operating channel and power level. See "RF Controls" on page 33.

Antenna Switch

When TX mode is in use only burst mode can be used. Antenna switch is controlled with a pulse in control line. This antenna switch control signal can be measured in points TX16. See "Plot 7. Power detector control" on page 55.

Antenna switch operation can be checked by measuring the signal level from points TX12 and TX21 . Specified loss for the antenna switch is 1.2 dB but measurement can show more attenuation depending on the method used. Check the level from the reference phone measurements.

PA-Module, Directional Coupler and Power Detector

At first the input signal level of the PA should be checked. Input signals can be measured from point TX15.

Refer the levels to the reference phone measurements and the *RF Testpoints* section.

Output of the PA can be checked by measuring the DET0 signal coming out from the detector. Measure DET0 from TX11, See "Plot 7. Power detector control" on page 55.
If this is OK then PA module, Directional coupler and Power Detector are operational.

If DET0 is not ok, check the supply of the detector TXVdet, TX6, and check also the input of the detector by measuring the point TX22 with a spectrum analyzer.

If the TX6 is ok but TX22 is not, then check PA power control line Vpd. If Vpd is ok, check the components in RF signal path and check the PA supply voltage.

HAGAR

Power Control

Check the TXC point TX10 DET0 point TX11 and Vpd point TX19

.Refer to the results in plots 4 & 7. If only Vpd fails, then Hagar power control has problems.

RF path

If RF output from HAGAR seems at fault then IQ input signals from BB to Hagar should be tested. These signals can be measured from points TX8 and TX9 and signals can be referred to See "Plot 8. TX IQ signals" on page 55.

Synthesizer Fault Finding

General

To test VCO frequency properly spectrum analyzer has to be able to measure 4GHz frequencies.

VCTCXO

VCTCXO signal can be measured from point VXO3 and VXO4. VXO4 is the 13MHz clock signal for BB parts and VXO3 is 26 MHz signal for Hagar. See "Plot 10. Clock signals, VCTCXO, RFC" on page 56. If 13 MHz is not present but 26 MHz is, Hagar divider has a problem. If 26 MHz is not present, then VCTCXO has problem.

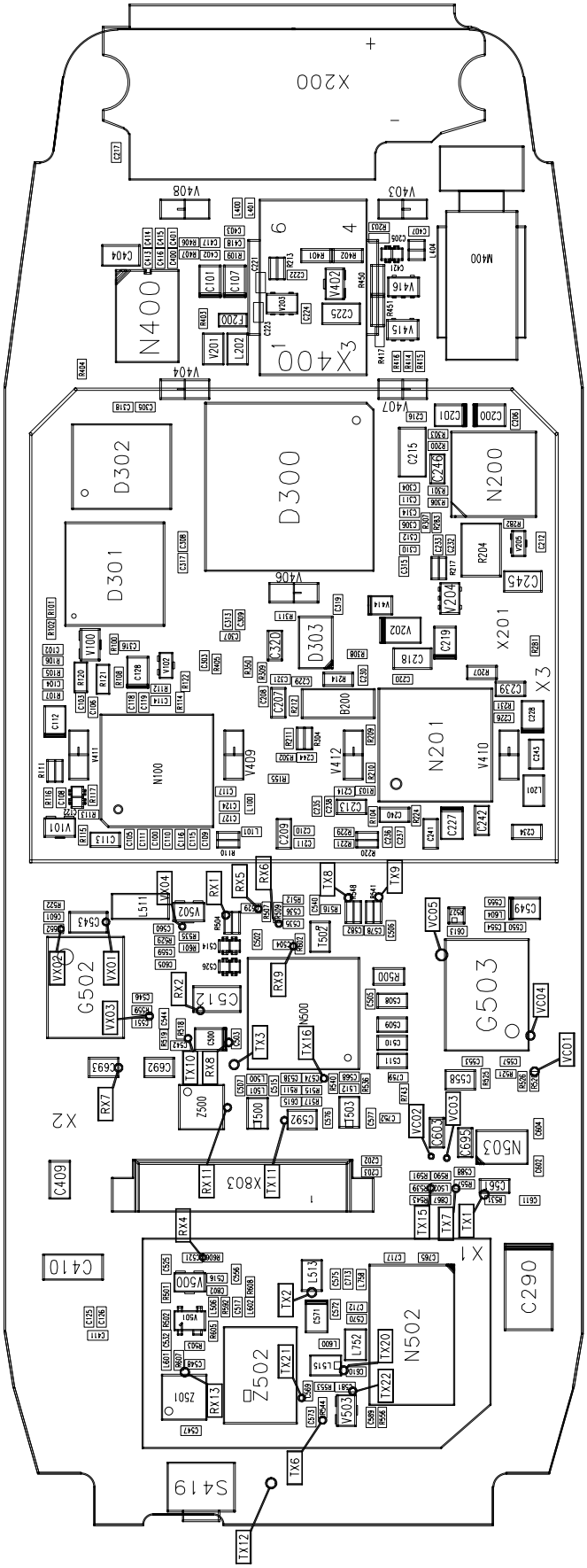
VCO

The VCO signal can be measured at point VCO5. VCO operation can be checked also by oscilloscope measuring the control voltage in RX burst mode. Additional settings should be GSM1900 mode, RX burst mode, channel 810 and monitoring channel 512. See "Plot 9. VCO, operating voltages" on page 56.

If the VCO is not operating check Vcc (points VCO1, VCO3 and VCO2) If supply voltages are ok the VCO has a problem.

©Nokia Mobile Phones Ltd.

RF Testpoints



©Nokia Mobile Phones Ltd

Measuring Points

RX

DC levels (oscilloscope)

Point	Signal	Component	Comment	Plot
RX1	RXIP and RXQP	R504	I/Q signals (67 kHz) from Hagar to COBBA.	1
RX2	RXIP and RXQP	C512	Same that RX1 but before AGC state	2
RX4	DCS LNA ctrl	R606 / V500	~2.8 V burst controls LNA ON/OFF	3
RX5	Rxref	C529 / R507	DC 1.2 V from COBBA to Hagar	na
RX6	VREF_2	C535 /R509	DC 1.5 V from CCONT to Hagar	na
RX7	Vlna	C693	DC 2.8 V from CCONT to Hagar	3
RX8	Vrxrf	C503 / C500	DC 2.8 V from CCONT to Hagar	na
RX9	Vsynte	C504	DC 2.8 V from CCONT to Hagar	na

©Nokia Mobile Phones Ltd.

RF levels (spectrum analyzer)

Point	Signal	Comp.	Comment
RX11	1930...1990 MHz	Z500	Second saw-filter DCS output to baluns, (-41dBm) (check level from reference engine)
RX13	1930...1990 MHz	Z501	First saw-filter DCS output to LNA, (-58dBm) (check level from reference engine)

TX

DC levels

Point	Signal	Component	Comment	Plot
TX1	TX power level	C561 / R531	PA selection and control	4
TX2	Vdd1	L513 / C571	Battery voltage to PA Vbatt 3.3 ... 4.8 V	5
TX3	TXP	J503	TX control signal (antenna switch, differential amplifier)	
TX16	TXVDCS	C574	~2.5 V burst controls antenna switch	6
TX6 TX7	TXVdet DET0	C573 / R544 R557 / C588	Operating voltage to TX detector 2.8 V burst and detected TX level to HAGAR	7
TX8	TXQ	R548	TX Q signals from baseband to Hagar (+ - 67 kHz, DC level 1.2 V, swing level 1.32 V)	8
TX9	TXI	R541	TX I signals from baseband to Hagar (+ - 67 kHz, DC level 1.2 V, swing level 1.32 V)	8
TX10	TXC	R518 / C542	TX power control voltage from baseband to Hagar 0...2.2 V burst	4

©Nokia Mobile Phones Ltd

RF levels

Point	Signal	Component	Comment
TX11	DET0	C615 / C592	Detected TX level to HAGAR
TX12	RX and TX	Z600 / ant.	Final TX frequency and level, (28 dBm, GSM 1900 / lev 0) (check level from reference engine)
TX20	PA output DCS	C610	PA output signal (check level from reference engine)
TX21	Antsw input DCS	Z502 / C569	Antsw input signal (check level from reference engine)
TX15	PA input DCS	L502 / R539	PA input signal
TX22	PWR detector input	V503 input / C581	14 dB below TX output (check level from reference engine)

VCO

DC levels

Point	Signal	Component	Comment	Plot
VCO1	VCC	R526 / R520	2.64 V DC VCO operating voltage	9
VCO2	Vchp	J517	4.7 V DC from reg. N600 to VCO	9
VCO3	VCP	J515	5.0 V DC from CCONT to reg. N600	9
VCO4	VC	R521 / G503	0.5 V ... 4.2 V burst DC from Hagar to VCO	9

RF levels

Point	Signal	Component	Comment
VCO5	3700...3980 MHz	G503 / R527	VCO signal needs 4 GHz spectrum analyzer.*) level ~0dBm (check level from reference engine).

*) RF input signal of PA and VCO operating voltages can be used to check VCO condition if only a 3GHz spectrum analyzer is available.

©Nokia Mobile Phones Ltd.

VCTCXO

DC levels

Point	Signal	Component	Comment
VXO1	Vtcxo	G502	VCTCXO operating voltage from CCONT DC 2.8 V
VXO2	AFC	R522 / C601	AFC from COBBA to VCTCXO DC 0.046...2.254 V

RF levels

Point	Signal	Component	Comment	Plot
VXO3	26 MHz	G502 / C551	Clock signal from VCTCXO to Hagar	10
VXO4	13 MHz	V502 / R535	RFC from Hagar to MAD	10

Other checking points

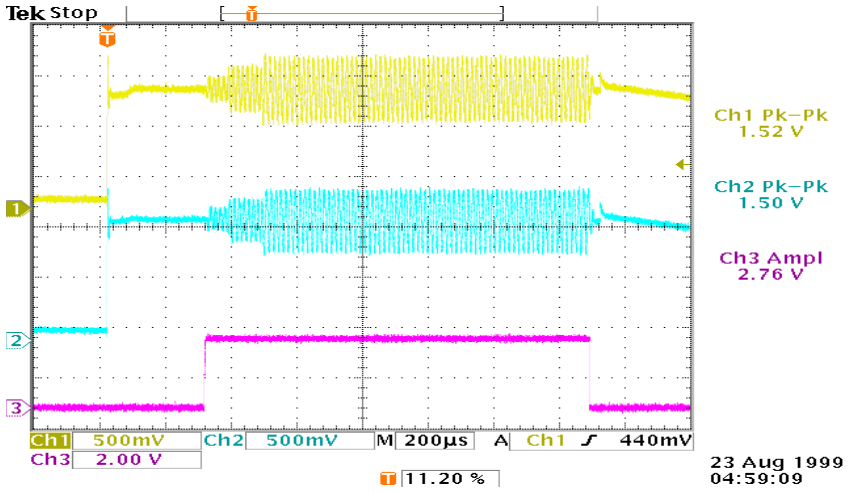
SCLK R205
SENA R206
SDATA J237

©Nokia Mobile Phones Ltd

Measurement Points -Waveforms

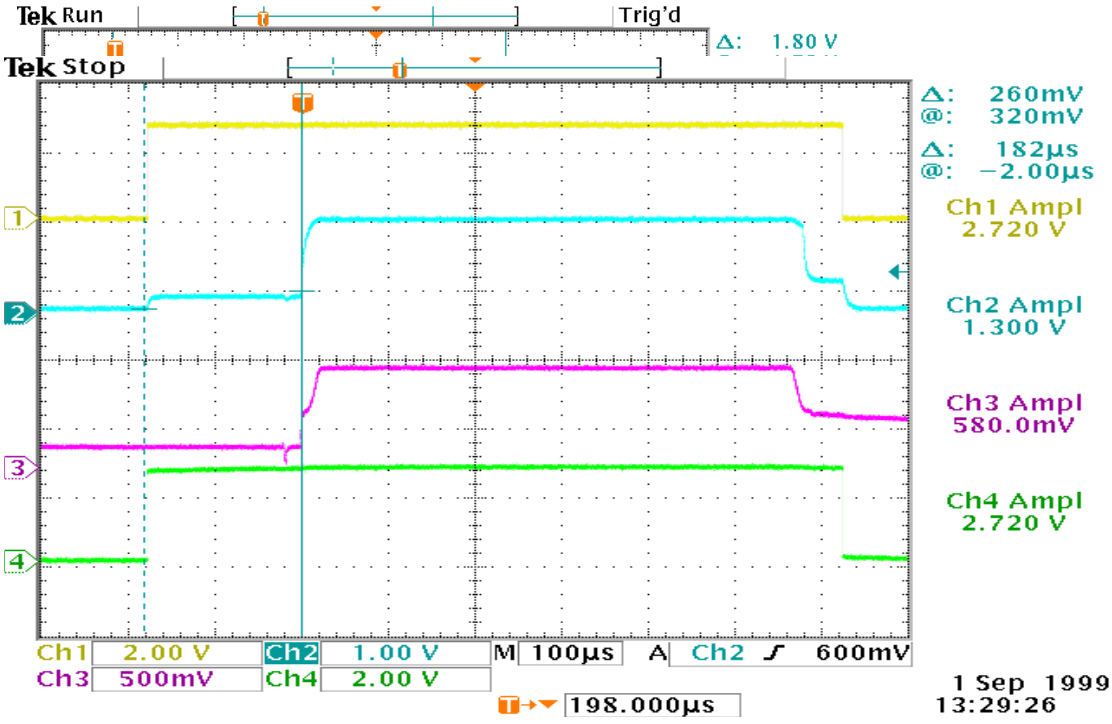
Plot 1. RX I/Q from Hagar to baseband

Pin = -58dBm, Fin = 1960.06771MHz (RSSI Reading ≈ -60dBm)
Channel 1: RX1 RXIP R504
Channel 2: RX1 RXQP R504
Channel 3: RX4 LNA_G V500
notice the premonitoring steps at the beginning of the burst



Plot 2. RX I/Q before AGC

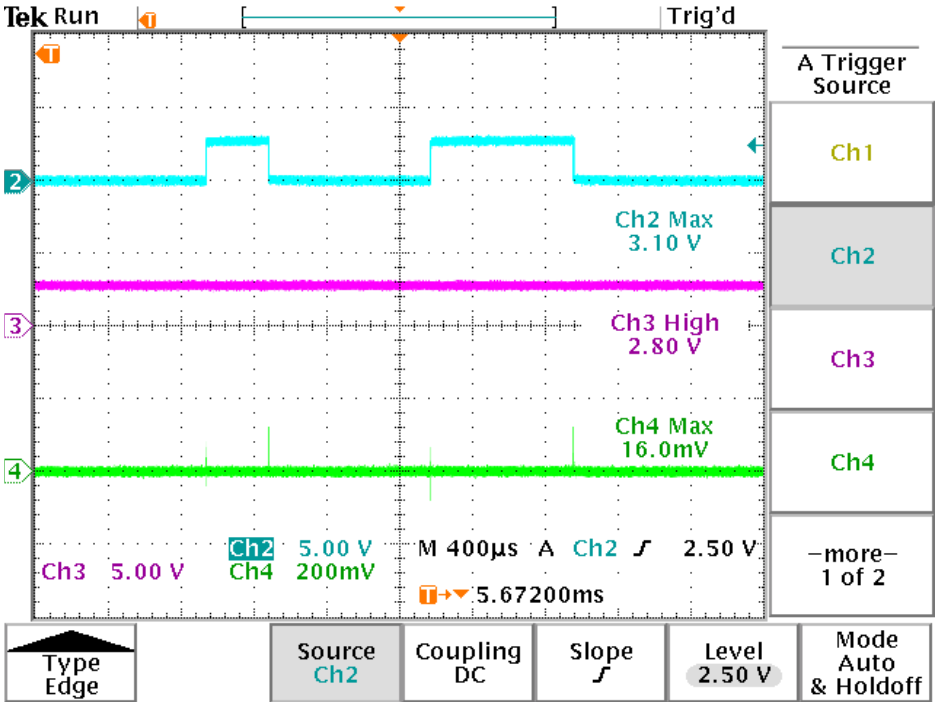
Pin = -50dBm, Fin = 1960.06771MHz
Channel 1: RX2 C512



©Nokia Mobile Phones Ltd.

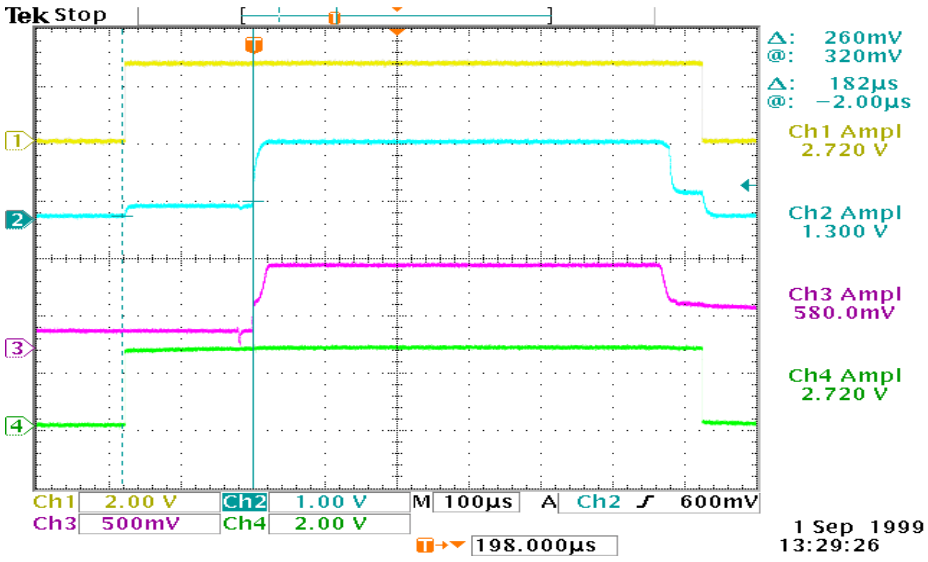
Plot 3. LNA control

Channel 2: RX4, base of V500
Channel 3: RX7: Vlna



Plot 4. PA selection and control

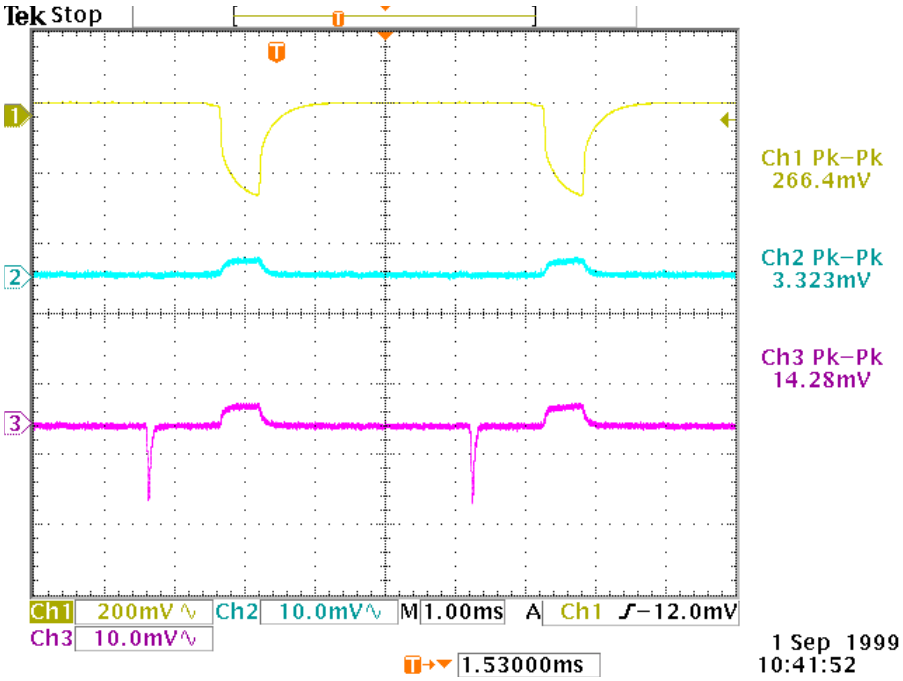
Condition: DCS TX, burst mode power level 5
Channel 1: TX3 TXP, J503
Channel 2: TX1 C561, Vpd DCS
Channel 3: TX10, C542, TXC DCS
Channel 4: TX5, C752, VtxB DCS



©Nokia Mobile Phones Ltd

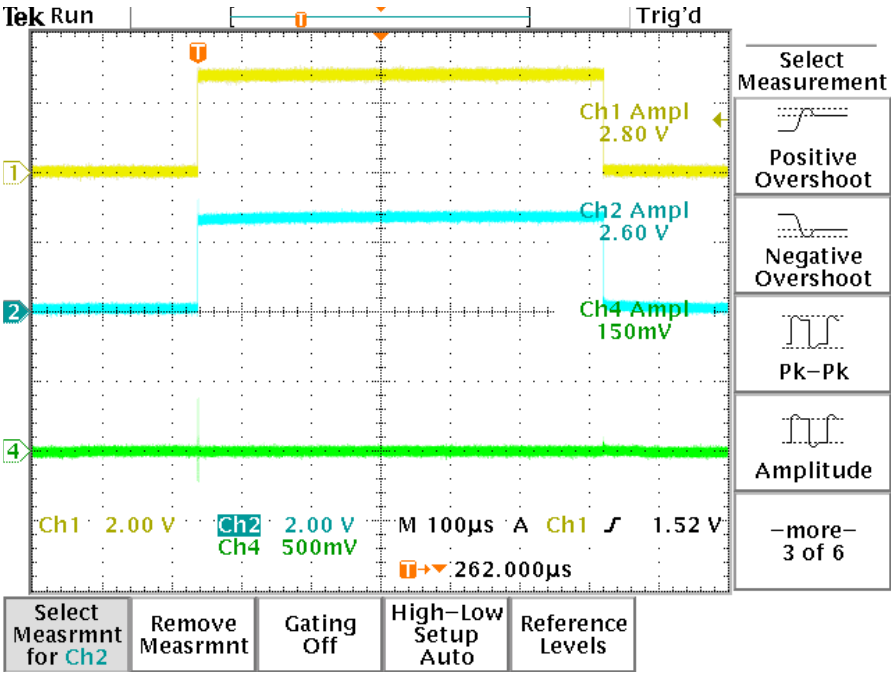
Plot 5. VBATT during TX burst

Condition: DCS TX burst mode power level 0
Channel 2: VCO1
Channel 3: VCO4 Channel 1:TX2, VBATT



Plot 6. Switch control

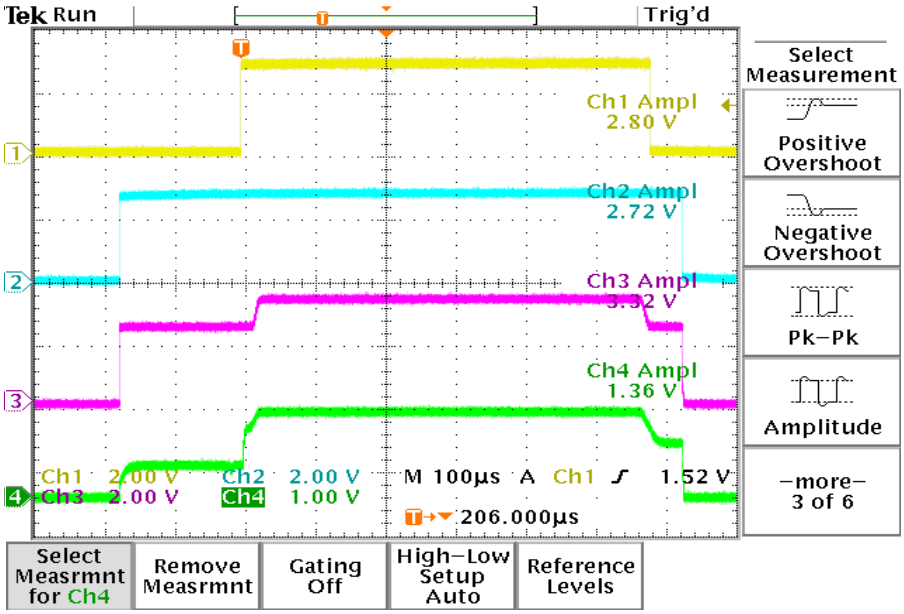
Channel 1:TX3: TXP, J503,
Channel 2:TX16: C574, TXVDCS



©Nokia Mobile Phones Ltd.

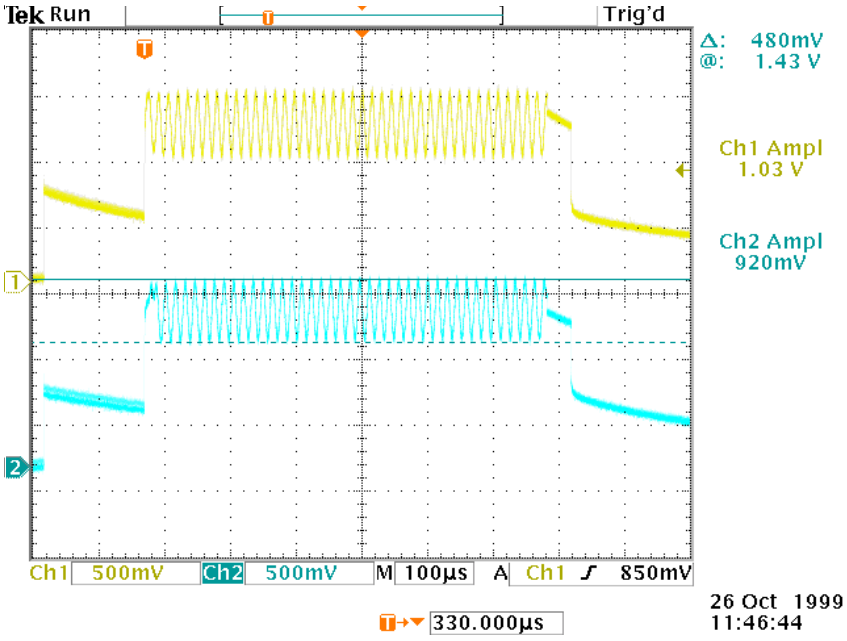
Plot 7. Power detector control

Condition: DCS TX, burst mode powerlevel 5
Channel 4: TX11: C615, DET0,
Channel 3: TX7: C588, DET0,
Channel 2: TX6: C574, TXVDET,
Channel 1: TX3: TXP, J503,



Plot 8. TX IQ signals

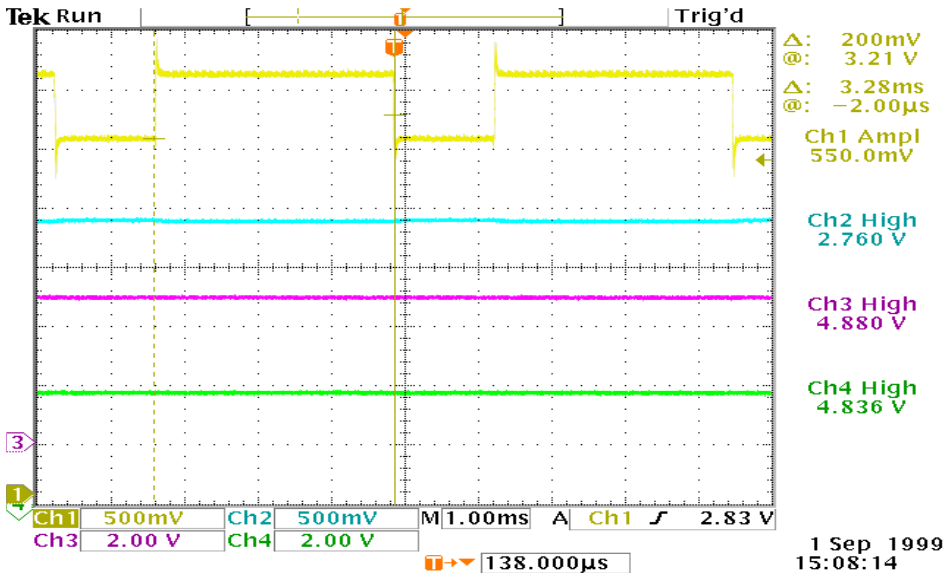
Channel 1: TX8 TXQN
Channel 2: TX9 TXIN
(TX burst mode Cont1)



©Nokia Mobile Phones Ltd

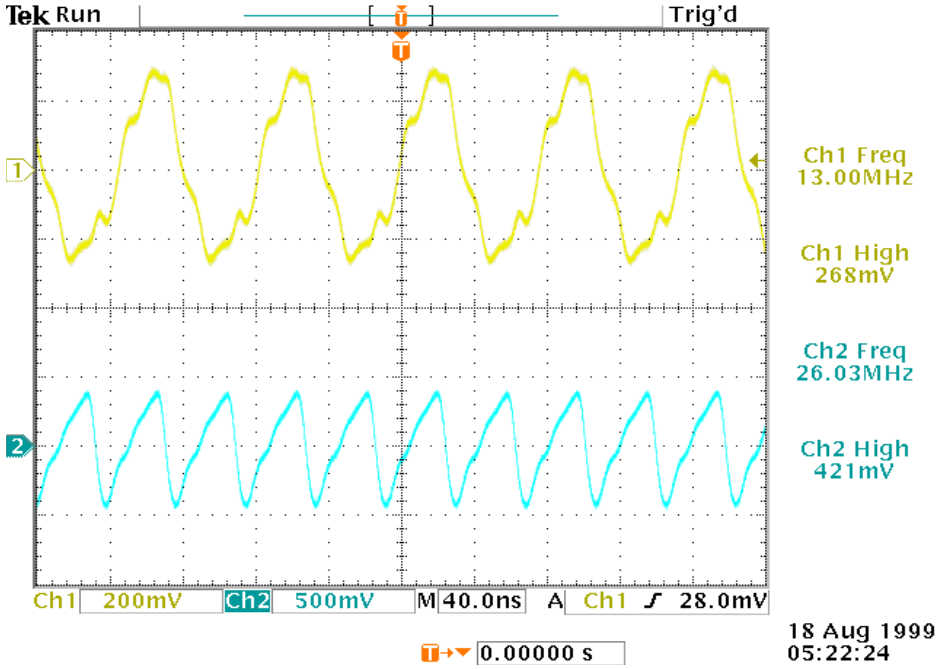
Plot 9. VCO, operating voltages

Conditions: DCS, RX in burst mode, RX ch810, Monitoring ch512
Channel 1: VCO4
Channel 2: VCO1
Channel 3: VCO3
Channel 4: VCO2



Plot 10. Clock signals, VCTCXO, RFC

Channel 1: VXO3, RFC
Channel 2: VXO4, VCTCXO_out



©Nokia Mobile Phones Ltd.